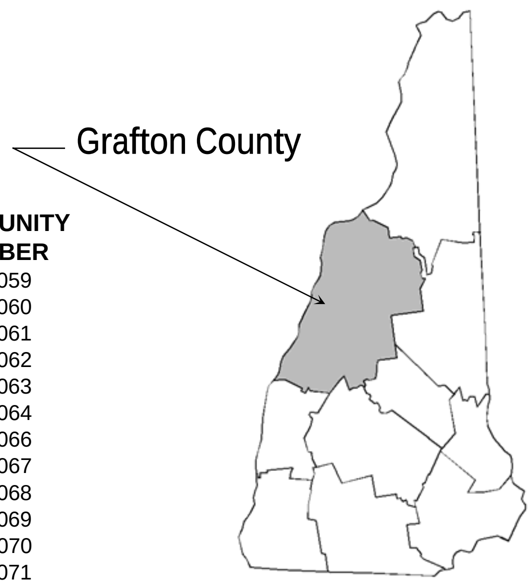
FLOOD INSURANCE STUDY

VOLUME 1 OF 3

GRAFTON COUNTY, NEW HAMPSHIRE
(ALL JURISDICTIONS)



COMMUNITY NAME	COMMUNITY NUMBER	COMMUNITY NAME	COMMUNITY NUMBER
ALEXANDRIA, TOWN OF	330041	HOLDERNESS, TOWN OF	330059
ASHLAND, TOWN OF	330042	LANDAFF, TOWN OF	330060
BATH, TOWN OF	330043	LEBANON, CITY OF	330061
BENTON, TOWN OF*	330044	LINCOLN, TOWN OF	330062
BETHLEHEM, TOWN OF	330045	LISBON, TOWN OF	330063
BRIDGEWATER, TOWN OF	330046	LITTLETON, TOWN OF	330064
BRISTOL, TOWN OF	330047	LYMAN, TOWN OF	330066
CAMPTON, TOWN OF	330048	LYME, TOWN OF	330067
CANAAN, TOWN OF	330049	MONROE, TOWN OF	330068
DORCHESTER, TOWN OF	330050	ORANGE, TOWN OF	330069
EASTON, TOWN OF	330051	ORFORD, TOWN OF	330070
ELLSWORTH, TOWN OF	330205	PIERMONT, TOWN OF	330071
ENFIELD, TOWN OF	330052	PLYMOUTH, TOWN OF	330072
FRANCONIA, TOWN OF	330053	RUMNEY, TOWN OF	330073
GRAFTON COUNTY, UNINCORPORATED AREAS*	330003	SUGAR HILL, TOWN OF	330074
		THORNTON, TOWN OF	330075
GRAFTON, TOWN OF	330054	WARREN, TOWN OF	330168
GROTON, TOWN OF	330055	WATERVILLE VALLEY, TOWN OF	330077
HANOVER, TOWN OF	330056		
HAVERHILL, TOWN OF	330057	WENTWORTH, TOWN OF	330078
HEBRON, TOWN OF	330058	WOODSTOCK, TOWN OF	330079

*No Special Flood Hazard Areas Identified

REVISED: PRELIMINARY 04/14/2017

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
33009CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: February 20, 2008

Revised Countywide FIS Date:

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FLOOD INSURANCE STUDY
GRAFTON COUNTY, NEW HAMPSHIRE (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Grafton County, New Hampshire, including: the City of Lebanon and the Towns of Alexandria, Ashland, Bath, Benton, Bethlehem, Bridgewater, Bristol, Campton, Canaan, Dorchester, Easton, Ellsworth, Enfield, Franconia, Grafton, Groton, Hanover, Haverhill, Hebron, Holderness, Landaff, Lincoln, Lisbon, Littleton, Lyman, Lyme, Monroe, Orange, Orford, Piermont, Plymouth, Rumney, Sugar Hill, Thornton, Warren, Waterville Valley, Wentworth, and Woodstock (hereinafter referred to collectively as Grafton County). The Town of Livermore is now an unincorporated area.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Grafton County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the incorporated communities within Grafton County in a countywide format. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Bath, Town of:	the hydrologic and hydraulic analyses from the FIS report dated April 15, 1992, were prepared by the New England Division of the U.S. Army Corps of Engineers (USACE) during the

preparation of a Floodplain Information Report on the Ammonoosuc River in the Town of Bath.

Bridgewater, Town of:	for the original study dated June 17, 1991, the hydrologic and hydraulic analyses were prepared by the U.S. Geological Survey (USGS), for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. That work was completed in January 1990. For the FIS report dated June 4, 1996, the hydrologic and hydraulic analyses were prepared by the USGS, for FEMA, under Inter-Agency Agreement No. EMW-92-E-3847, Project Order No. 1. That work was completed in July 1993.
Bristol, Town of:	for the original October 1979 FIS report, the hydrologic and hydraulic analyses were prepared by the Soil Conservation Service (SCS, currently U.S Department of Agriculture Natural Resources Conservation Service [USDA NRCS]) for the Federal Insurance Administration (FIA) under Inter-Agency Agreement No. IAA-I-I-8-77, Project Order No. 15. That work was completed in November 1978. For the FIS report dated May 18, 1998, the hydrologic and hydraulic analyses for Newfound Lake were prepared by Green International Affiliates, Inc., for FEMA, under Contract No. EMW-93-C-4144, Task No. 13. That work was completed in October 1995.
Canaan, Town of:	the hydrologic and hydraulic analyses from the FIS report dated May 17, 1988, were prepared by the Soil Conservation Service (USDA NRCS) for FEMA under Inter-Agency Agreement No. EMW-84-E-1150, Project Order No. 1. That work was completed in May 1988.
Enfield, Town of:	the hydrologic and hydraulic analyses from the FIS report dated May 17, 1988, were prepared by the USDA NRCS for FEMA, under Inter-Agency Agreement No. EMW-84-E-1150, Project Order No. 1. That work was completed in April 1986.

Franconia, Town of:	the hydrologic and hydraulic analyses from the FIS report dated May 15, 1991, were prepared by the USDA NRCS for FEMA, under Inter-Agency Agreement No. EMW-87-E-2511, Project Order No. 1. That work was completed in March 1989.
Groton, Town of:	the hydrologic and hydraulic analyses from the FIS report dated October 18, 1982, were prepared by Hamilton Engineering Associates, Inc., for FEMA, under Contract No. EMW-C-0334. That work was completed in February 1981.
Hanover, Town of:	the hydrologic and hydraulic analyses from the FIS report dated January 1978 were performed by Anderson-Nichols and Company, Inc., for the FIA, under Contract No. H-3862. That work was completed in October 1976.
Haverhill, Town of:	the hydrologic and hydraulic analyses from the FIS report dated May 3, 1990, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. That work was completed in May 1988.
Holderness, Town of:	for the original October 15, 1980, FIS report and the April 15, 1981, FIRM (hereinafter referred to as the 1981 FIS), the hydrologic and hydraulic analyses were prepared by the U.S. Department of Agriculture, USDA NRCS, for the FIA, under Inter-Agency Agreement No. IAA-H-8-77, Project Order No. 15. That work was completed in August 1978. For the revision dated June 20, 2001, the hydraulic analyses for the Pemigewasset River were prepared by the New Hampshire Department of Transportation (NHDOT). That work was completed in March 1998.
Lebanon, City of:	the hydrologic and hydraulic analyses from the original FIS report dated May 19, 1987, prepared by the USACE for FEMA, under Inter-Agency Agreement No. IAA-H-2-73, Project Order No. 1, incorporated an updated hydraulic analysis for a portion of the Mascoma River, which includes the breached Cummings Tannery Dam. That work was prepared by the Rivers Engineering

Corporation, and was completed in February 1986.

For the August 15, 1990, FIS report, another portion of the Mascoma River was the subject of an updated hydraulic analysis that included channel modifications near the State Route 12A bridge and the rebuilt Grafton County Power Plant Dam No. 3 (Glen Hydro Dam). This work was prepared by the Maine Office of the USGS. Updated hydrologic and hydraulic analyses for the Connecticut River were prepared by Dufresne-Henry, Inc. That work was completed in October 1988.

Lincoln, Town of:	the hydrologic and hydraulic analyses from the FIS report dated April 20, 2000, were prepared by the USACE, New England District for FEMA. That study was completed in June 1996.
Lisbon, Town of:	the hydrologic and hydraulic analyses from the FIS report dated August 19, 1986, were performed by the USDA NRCS of the U.S. Department of Agriculture during preparation of a Floodplain Management Study for the Ammonoosuc River. This study was done in cooperation with the State of New Hampshire Office of State Planning, Grafton Conservation District, and the Town of Lisbon. That study was completed in May 1983.
Littleton, Town of:	the hydrologic and hydraulic analyses from the FIS report dated May 17, 1989, were prepared by the USACE for FEMA, under Inter-Agency Agreement No. EMW-E-0941. That work was completed in October 1986.
Lyme, Town of:	the hydrologic and hydraulic analyses from the FIS report dated April 16, 1993, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-88-E-2738, Project Order No. 3. That work was completed in April 1990.
Orford, Town of:	the hydrologic and hydraulic analyses from the FIS report dated April 15, 1992, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-88-E-1738, Project Order

No. 20. That work was completed in December 1989.

Plymouth, Town of: For the November 3, 1981, FIS report and May 3, 1982, FIRM (hereinafter referred to as the 1982 FIS), the hydrologic and hydraulic analyses for the Pemigewasset River, Baker River, and Sanborn Mill Brook were prepared by the USDA NRCS for FEMA, under Inter-Agency Agreement No. IAA-H-11-79, Project Order No. 15. That work was completed in December 1979.

For the May 21, 2001, FIS, the hydrologic and hydraulic analyses for the Pemigewasset River were prepared by the NHDOT for FEMA. That work was completed on March 27, 1998.

Rumney, Town of: the hydrologic and hydraulic analyses from the FIS report dated October 18, 1982, were prepared by Hamilton Engineering Associates, Inc., for FEMA, under Contract No. EMW-C-0334. That work was completed in July 1981.

Warren, Town of: the hydrologic and hydraulic analyses from the FIS report dated October 18, 1982, were prepared by Hamilton Engineering Associates, Inc., for FEMA, under Contract No. EMW-C-0334. That work was completed in September 1981.

Wentworth, Town of: the hydrologic and hydraulic analyses from the FIS report dated October 18, 1982, were prepared by Hamilton Engineering Associates, Inc., for FEMA, under Contract No. EMW-C-0334. That work was completed in July 1981.

Woodstock, Town of: For the original May 15, 1991, FIS, the hydrologic and hydraulic analyses were prepared by the USDA NRCS for FEMA, under Inter-Agency Agreement No. EMW-87-E-2511, Project Order No. 1. That work was completed in December 1988.

For the April 6, 2000, FIS, the hydrologic and hydraulic analyses for the East Branch Pemigewasset River were prepared by the USACE, New England District. That work was completed in June 1996.

The authority and acknowledgments for the Towns of Alexandria, Ashland, Benton, Bethlehem, Campton, Dorchester, Easton, Ellsworth, Grafton, Hebron, Landaff, Lyman, Monroe, Orange, Piermont, Sugar Hill, Thornton, and Waterville Valley are not available because no FIS reports were ever published for those communities.

For the February 20, 2008 countywide FIS, revised hydrologic and hydraulic analyses for Canaan Street Lake in the Town of Canaan, and Squam Lake in the Town of Holderness, were prepared by the USGS under Inter-Agency Agreement No. EMW-2000-IA-0365, Project Order No. 1. This work was completed in March 2002 for the Town of Canaan, and February 2004 for the Town of Holderness.

Base map information shown on this FIRM was derived from USGS Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1998 or later. These images were recast by the New Hampshire Geographically Referenced Analysis and Information Transit System (NH GRANIT) onto the New Hampshire State Plane Coordinate System.

The digital FIRM was produced using New Hampshire State Plane Coordinate System, FIPSZONE 2800, referenced to the North American Datum of 1983 (NAD 83), GRS80 spheroid.

For this revision, Phase I and II of the Levee Analysis and Mapping Procedure (LAMP) was performed for the Lincoln Levee System by STARR under Contract #HSFEHQ-09-D-0370, Task Order # HSFE01-14-J-0015. Phase III and the revised hydraulic analyses were performed for the East Branch Pemigewasset River by Compass under Contract #HSFE60-15-D-0003, Task Order # HSFE01-15-J-0001. FIRM Panels 33009C0290F, 33009C0310F, 33009C0435F, 33009C0440F, 33009C0441F, 33009C0445F, 33009C0455F, and 33009C0465F were revised. This work was completed in March 2017.

Base map information shown on this FIRM was derived from USGS Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1998 or later. These images were recast by NH GRANIT onto the New Hampshire State Plane coordinate system. Orthophotography shown on the FIRM was provided by the National Agriculture Imagery Program, 2016.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for Grafton County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings."

TABLE 1 - INITIAL AND FINAL CCO MEETINGS

Community	Initial CCO Date	Final CCO Date
Bath, Town of	May 10, 1990	September 10, 1990
Bridgewater, Town of	March 24, 1994[1]	July 8, 1994
Bristol, Town of	*	October 25, 1996
Canaan, Town of	August 16, 2000	*
Enfield, Town of	May 1984	October 30, 1987
Franconia, Town of	April 1987	January 22, 1990
Groton, Town of	June 1979	August 24, 1981
Hanover, Town of	September 1975	November 19, 1976
Haverhill, Town of	February 11, 1985	January 13, 1989
Holderness, Town of	August 16, 2000	*
Lebanon, City of	*	December 6, 1978
Lisbon, Town of	*	September 19, 1985
Littleton, Town of	August 3, 1983	February 8, 1988
Lyme, Town of	August 26, 1987	October 5, 1990
Orford, Town of	August 25, 1987	*
Plymouth, Town of	June 2, 1998[1]	*
Rumney, Town of	June 1979	December 21, 1981
Warren, Town of	June 1979	March 17, 1982
Wentworth, Town of	June 1979	January 18, 1982
Woodstock, Town of	August 15, 1997	September 21, 1998

*Data not available
[1]Notified by letter

For the February 20, 2008 countywide FIS, an initial CCO meeting was held on August 16, 2000, and was attended by representatives of the USGS, FEMA, New Hampshire Office of Emergency Management, and the New Hampshire Office of State Planning.

A final CCO meeting was held on June 21 and 22, 2006, and was attended by representatives of Grafton County, Dewberry, and FEMA.

For this revision, an initial stakeholder meeting was held on March 9, 2015, and was attended by FEMA, STARR, and representatives of Grafton County. A Flood Risk Review Meeting was held at Lincoln Town Hall on February 28, 2017 to discuss the initial results of the new LAMP mapping and was attended by FEMA, Compass, New Hampshire Office of Energy and Planning (NHOEP), and representatives of Grafton County. A final CCO meeting was held on ________________, and was attended by ________________________, and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Grafton County, New Hampshire.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Ammonoosuc River	Lovejoy Brook
Baker Brook	Mascoma Lake
Baker River	Mascoma River
Beede Brook	Mink Brook
Canaan Street Lake	Monahan Brook
Clay Brook-Trout Brook	Newfound Lake
Cockermouth River	Newfound River
Connecticut River	Orange Brook
Dells Brook	Ore Hill Brook
East Branch Pemigewasset River	Owl Brook
Eastman Pond	Palmer Brook
Farr Brook	Pemigewassett River
Goose Pond Brook	Punch Brook
Grant Brook	Sanborn Mill Brook
Ham Branch	Slade Brook
Hewes Brook	South Branch Baker River
Indian River	Squam Lake
Knox River	Stinson Brook

February 20, 2008 Countywide FIS

Revised hydrologic and hydraulic analyses for Canaan Street Lake in the Town of Canaan, and Squam Lake in the Town of Holderness, were prepared by the USGS. The analysis resulted in revisions to the FIRM for the towns of Canaan and Holderness.

Lincoln Levee System Update

The revised analysis for the Lincoln Levee System update was prepared by Compass. This new analysis resulted in revisions to FIRM panels 33009C0290F, 33009C0310F, 33009C0435F, 33009C0440F, 33009C0441F, 33009C0445F, 33009C0455F, and 33009C0465F in the towns of Benton, Easton, Franconia, Lincoln, Bethlehem, Woodstock, and Thornton; and Grafton County Unincorporated Areas.

For flooding sources studied by detailed methods for the February 20, 2008 Countywide FIS and for this revision, see Table 3, "Scope of Revision."

TABLE 3 - SCOPE OF REVISION

Stream	Limits of Revised or New Detailed Study
Canaan Street Lake[1]	For its entire shoreline
Squam Lake[1]	For its entire shoreline within the county
East Branch Pemigewasset River[2]	Area surrounding the Lincoln Levee System

[1]Revised for February 20, 2008 Countywide FIS
[2]Revised for Lincoln Levee System Update

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 4, "Letters of Map Revision."

TABLE 4 - LETTERS OF MAP REVISION

Community	Flooding Source(s)/Project Identifier	Date Issued	Type
Town of Holderness	Pemigewasset River	March 13, 2003	LOMR
Town of Plymouth	Baker River	December 14, 2002	LOMR
Town of Bristol	Newfound Lake	November 6, 2000	LOMR
Town of Bridgewater	Newfound Lake	December 5, 1997	LOMR
Town of Littleton	Ammonoosuc River-Dells Brook	June 9, 1995	LOMR

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Grafton County.

2.2 Community Description

Grafton County is located in the northwestern portion of New Hampshire. It is bordered to the north by Coos County, New Hampshire, and Caledonia County, Vermont; to the east by Carroll County, New Hampshire; to the southeast by Belknap and Merrimack Counties, New Hampshire; to the south by Sullivan County, New Hampshire; and to the west by Orange and Windsor Counties, Vermont. The population in Grafton County was 81,743, according to the 2000 U.S. Census (U.S. Census Bureau, 2000).

The climate of northern New England is cold, snowy winters and warm, rainy summers. The mean annual precipitation is approximately 45 inches. Mean annual snowfall is approximately 75 inches. Summer temperatures average approximately 66 degrees Fahrenheit (°F) with maximum temperatures of 90°F. Winter temperatures average approximately 16°F, with extremes well below 0°F.

The soils in the Cockermouth River Basin are primarily of the Becket-Lyman-Hermon association, which is characterized by high permeability. Soils in the Pemigwasset River Basin are primarily of the Ondawa-Windsor-Agawam association and are characterized by rapid permeability and moderate susceptibility to frost action. The terrain of Grafton ranges from gently rolling hills to steep hills, with elevations ranging from 350 feet to 1,500 feet. Major transportation arteries are Interstate Routes 91 and 93; U.S. Route 302; and State Routes 10, 18, 116, and 135.

2.3 Principal Flood Problems

Floods in Grafton County have occurred in every season of the year. Spring floods are common and are caused by rainfall combined with snowmelt. Floods in late summer and fall are usually the result of above normal precipitation from hurricanes. Winter floods result from the occasional thaws and rainfall, particularly in years of heavy snow cover.

Major floods of this century in the Towns of Bridgewater, Hanover, Haverhill, Littleton, Lyme, and Orford have occurred in March 1913, November 1927, March 1936, September 1938, June 1943, and July 1973. Of these, the flood of July 1973 was the most severe. Long-term streamflow records (1949 to present) at USGS gaging station No. 01138500, Connecticut River at Wells River, Vermont, indicates that the July 1973 flood had a recurrence interval of less than 100 years.

A number of large floods have occurred on the Mascoma River since the USGS gage (No. 01150500) was installed approximately 1,000 feet downstream from Mascoma Lake. This gage measures runoff from 153 of the total 194-square mile Mascoma River watershed. The lake has a pronounced desynchronizing effect on flood flows; consequently, peak discharges in Lebanon are principally a function of runoff from the 153-square mile watershed above the gage, with some contribution to peak runoff from the steep and mountainous local area below the gage. The four worst floods occurred in March 1936, March 1953, September

1938, and July 1973. The respective discharges associated with these events are 5,840 cubic feet per second (cfs); 4,880 cfs; 4,400 cfs; and 3,660 cfs. The estimated return period for floods of these magnitudes are 117 years, 50 years, 30 years, and 14 years, respectively. These floodwaters caused damage to buildings and bridges within the Towns of Canaan and Enfield.

Other USGS gages used in this study are: gage No. 00145000, located on the Mascoma River at West Canaan; and gage No. 0107800, located on the Smith River approximately 18 miles to the west.

Long-term stream flow records (1903 to present) at USGS gaging station No. 01076500, Pemigewasset River at Plymouth, New Hampshire, indicates that the March 1936 flood had a discharge of 65,400 cfs and a recurrence interval of slightly more than 100 years.

There are many natural and man-made hydraulic constrictions along the stream. Ice jams and collection of debris generally compound flooding. On the Mascoma River, the presence of debris was not considered in computing the flood profiles because these situations are isolated. Ice jams on the Connecticut River are significant, however, and a full ice jam analysis was performed in the FIS for the Town of Hartland, Vermont (FEMA, 1988). Although a full analysis was not performed in this study, the effects of the analysis performed for the Town of Hartland were considered in computing flood profiles for the Connecticut River.

Large magnitude floods, caused by heavy rainfall alone or by a combination of heavy rain and melting snow, have occurred on both the Mascoma and Connecticut Rivers in Lebanon. Repeated damage has occurred to structures in the floodplains of the streams during such floods as those that occurred in 1913, 1922, 1927, 1933, 1936, 1938, 1953, and 1973. Ice jams and collection of debris are common of the Mascoma River, and such occurrences generally compound flooding.

The 1953 flood had a discharge of 73,300 cfs on the Connecticut River and 4,900 cfs on the Mascoma River, with a recurrence interval of approximately 15 years on the Connecticut River and 30 years on the Mascoma River. The 1927 flood is the maximum flood of record on the Connecticut River. This flood had a discharge of 136,000 cfs and a recurrence interval of well in excess of 100 years under present conditions. The 1936 flood is the maximum flood record on the Mascoma River. This flood had a discharge of 5,800 cfs and a recurrence interval of approximately 45 years.

Because there are no stream gages located on Ham Branch, discharges and estimated recurrence intervals are not available for historical flooding. However, the 1927, 1936, 1938, and 1959 floods damaged buildings and bridges in the Town of Franconia (U.S. Department of Interior, 1924-1986)

Ice jams and collections of debris are common on Ham Branch because of the many natural and man-made constrictions along the stream; because their occurrences are often isolated and unpredictable, they were not considered in the analyses prepared for this study.

In decreasing order of magnitude, the eight largest floods took place in 1926, 1942, 1973, 1936, 1959, 1938, 1953, and 1934. After 1969, the hydrology of the Baker River basin was significantly changed. In that year, the last of seven flood control dams, designed by the USDA NRCS, was completed. Since then, the severity of flooding has been greatly reduced. The same hydrometeorological event which would have produced a 100-year (1% annual chance) flood in excess of 30,000 cfs prior to construction of the dams, would presently produce a 1% annual chance flood of less than 17,000 cfs.

The most destructive flood in the initial 30 years of gaging occurred on June 14 and 15, 1942. Highways, railroad beds, homes and bridges were extensively damaged. The flow was gaged at 21,400 cfs and had a computed recurrence interval of 35 years.

The most significant flood in recent years occurred on June 30, 1973, when a discharge of 11,700 cfs was recorded at the Rumney gage and 47,600 cfs at the Plymouth gage. This flood had a recurrence interval of 30 years after adjustments had been made for the active flood control structures. This flood caused significant damage and major inconveniences throughout the Baker River valley.

On October 24, 1959, manufacturing plants and commercial establishments as well as farms, roads, and residences suffered significant damage from floodwaters surging at 18,000 cfs. This 12-year storm produced significant destruction in the watershed.

Several floods which occurred during the period between the Town of Wentworth's incorporation and the commencement of gaging in the 20th century were documented in the town's history. The freshet of 1856 that resulted from a heavy rainfall (9 inches in 48 hours) and a failed dam at Baker Pond, devastated much of Wentworth and most of the existing mills. A similar flood was recorded in 1869.

Floods in the Pemigewasset River basin may occur during all seasons of the year. Major floods occurred in 1785, 1824, 1826, 1830, 1839, 1852, 1869, 1878, 1895, 1896, 1927, 1936, 1938, and 1973. The flood of record on the Pemigewasset River occurred in March 1936.

Major floods in the Pemigewasset River basin are often caused by a combination of heavy rainfall and melting snow in the spring. The magnitude of these spring floods varies considerably depending on the water content of the snow cover, temperature variation, and the amount of rainfall during the snowmelt period. Major floods resulting from heavy rainfall alone can also be experienced during other seasons of the year as evidenced by the floods of November 1927, September 1938, and June 1973.

In November 1927, a flood resulted from a tropical storm which was forced inland. Records indicate that precipitation increased with altitude and, although no records were obtained in the White Mountains, it has been reported that nearly 9 inches of rain fell in the upper regions of the Pemigewasset River watershed. A peak discharge of 60,000 cubic feet per second (cfs) and a stage of 27.4 feet was recorded at the USGS gage in Plymouth and 25,900 cfs at the Rumney gaging station. This flood had a recurrence interval of approximately 90 years.

During March 1936, two floods occurred which resulted in the greatest flood of record. The floods were associated with two periods of heavy rainfall on March 11-12 and March 17-18. The second flood produced more serious flooding. However, the flooding was not due to rainfall alone but rather a combination of factors which are normally associated with spring runoff. The first flood left conditions of saturated ground, warm temperatures, melting snows, filled storage areas, and high river flows. These conditions, combined with the second flood, produced flood conditions for 10 days and produced a peak discharge of 65,400 cfs and a stage of 29 feet at the gage in Plymouth on March 19. This flood had a recurrence interval of approximately 130 years.

In September 1938, flooding occurred in the Pemigewasset River basin. From September 17 to 21, a period of heavy rainfall occurred, associated with the passage of a tropical storm. The total precipitation averaged 11.5 inches over New England. The flood had a peak discharge of 50,900 cfs, a stage of 23.6 feet, and a recurrence interval of approximately 40 years.

Several large floods have occurred along the Pemigewasset River since USGS gage No. 01075000 was installed at Woodstock. The most severe flood occurred in October 1959. The discharge from this flood was 47,000 cfs. The estimated return period for a flood of this magnitude is 90 years. This floodwater caused damage to buildings and bridges in the Town of Woodstock (U.S. Department of Interior, Geological Survey, 1924-1986).

Because of the many natural and man-made hydraulic constrictions along the stream, ice jams and collection of debris are common on the Pemigewasset River; these occurrences generally compound flooding. However, the presence of ice or debris was not considered in computing the flood profiles for this study, since these situations are isolated and unpredictable.

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, and developments in the floodplain. A 10-, 2-, 1-, or 0.2-percent annual chance flood on the Pemigewasset River, Beede Brook, or Owl Brook would result in the inundation of some residential, commercial, and agricultural properties in Holderness.

During floods, debris collecting on bridges and culverts could decrease their carrying capacity and cause greater water depths of backwater effect upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing profiles of the 10-, 2-, 1-, or 0.2-percent annual chance floods. All of the six bridges crossing the Pemigewasset River, Beede Brook, and Owl Brook are obstructive to the 10-percent annual chance flood. In some cases, bridges may be high enough so as not to be inundated by flood flows; however, the road approaches to these bridges may be at lower elevations and subject to flooding.

Water velocities during floods depend largely on the size and shape of the cross sections, conditions of the streams, and the channel bed slope, all of which vary on different streams and at different locations on the same stream. During a 1-percent annual chance flood, velocities of main channel flow in the study streams would be expected to range from 3 to 12 feet per second. Water flowing at this rate is capable of causing severe erosion to streambanks and fill around bridge abutments, as well as transporting large objects. Velocities of floodplain flow would be expected to range from one to four feet per second. Waters flowing at two feet per second or less would deposit debris and silt.

Depths of water during floods depend largely on the physical characteristics of the stream. These features vary greatly on different streams and at different locations on the same stream. During a 1-percent annual chance flood, depths along the Pemigewasset River will range between 30 to 40 feet in the main channel and 10 to 20 feet over the floodplain. On Beede and Owl Brooks, depths ranging from 5 to 12 feet in the main channel and 1 to 6 feet over the floodplain can be expected.

Major floods have occurred on the Ammonoosuc River in 1828, 1869, 1927, 1936, 1938, and 1973 during all seasons of the year. The greatest flood of record occurred in March 1936. Spring is the normal period of high river flow due to snowmelt and rainfall. As in most of the forested and agricultural sections in New England, the runoff potential varies greatly with the season. Flooding within the study area is affected primarily by the intensity and duration of rainfall in areas of the drainage basin upstream. Based on hydrographs of the floods of 1936 and 1938, the duration of flooding is usually 1 to 4 days through this area, and the rate of floodwater rise varies from 0.2 to 1.5 feet per hour.

Flooding on the Ammonoosuc River has been caused by several types of events. A combination of rainfall and snowmelt caused the floods of March 1936 and March 1953. Intense rainfall from an extratropical cyclone caused the flood of October 1959. Hurricane rainfall caused the floods of November 1927, September 1938, and June 1973. Ice jams, which can occur in winter or spring, are another cause of local flooding.

Damaging floods have been observed and recorded in the Bath area as early as 1828. Historic floods occurred in August 1928, October 1869, and November 1927; however, little data is available on floods prior to 1927. It is likely that the flood of November 1927 caused more damage than any of the earlier floods.

There is a USGS gaging station located on the Ammonoosuc River in Bethlehem Junction just upstream of the study area at river mile 35.0. Records for this 87.6 square mile area have been maintained since August 1939, with the maximum discharge after this date on October 24, 1959, of 10,800 cfs (U.S. Department of Interior, Geological Survey, 1982; USACE, 1978)

The flood of November 3-4, 1927, covered the entire Ammonoosuc River floodplain. Main Street was under up to 5 feet of water. Many of the buildings, plus several structures now removed, were subjected to the highest flood stages since at least 1780. This flood was estimated to be approximately a 150-year event.

The flood of June 1973 produced the second largest discharge in the Ammonoosuc River in the period of record, from 1935 to the present. The flood was caused by a hurricane. In an item from a general account of the flood (July 12, 1973), the damages in Bath were estimated to be in excess of $30,000.

Most major floods in Lisbon have occurred in the summer and fall. Torrential rain over the steep terrain of the White Mountains following an unseasonably wet period has created 5 of the 6 largest floods of record. The watershed upstream of Lisbon contains very few storage areas (swamps, lakes, large floodplains) where the impact of the excess runoff can be absorbed.

The USGS maintains a water stage recorder (No. 01-1380) on the Ammonoosuc River. This gage has been in operation since September 1935 and is located approximately 1.4 miles southwest of Bath. Crest stages and discharges (in cubic feet per second) for known floods at this gage are shown in the following tabulation:

Date of Crest	Stage (ft.)	Elevation (ft. msl)	Estimated Peak Discharge (cfs)
March 18, 1936	15.40	469.54	27,900
June 30, 1973	17.55*	471.69*	26,900*
September 21, 1938	15.07	469.21	26,800
October 25, 1959	14.28	468.42	23,500
March 27, 1953	13.83	467.97	21,900
December 21, 1973	15.32*	469.46*	20,800*

*The flood of June 1973 caused a shift in the rating curve at this gage of 2 to 4 feet depending on the flow. The shift was caused by sediment deposition in the channel.

Major floods in the Town of Bristol occurred in 1843, 1869, 1878, 1884, 1886, 1895, 1896, 1897, 1936, 1953, and 1973. The flood of record on the Newfound River occurred in March 1936, with a peak elevation of 593.5 feet at the gage on Newfound Lake (U.S. Department of Interior, Geological Survey, 1937). This elevation was 1.3 feet above the estimated 500-year flood. A factor contributing to such a high flood elevation was a restrictive lake outlet structure that has since been enlarged.

It is estimated that Newfound Lake will rise 4 feet above its normal summer level during the 1-percent annual chance flood, based on this revised study. Wind-generated waves will increase the water level above that indicated in the stillwater analysis, but their effects were not evaluated in this study.

The principal flood problems in the Town of Hanover are associated with Mink Brook because it has the most developed floodplain area. Mink, Monahan, and Slade Brooks flow directly from the surrounding mountains and, therefore, have steep slopes and very little storage capacity. Rapid rates of rise and high velocities result from this configuration and can cause flash floods. Where Mink Brook levels off, its floodplain becomes wider; consequently, floods can inundate a large area. Due to a large drainage area, the Connecticut River can inundate its floodplain for a day or longer.

The Town of Littleton is subject to flooding from the Ammonoosuc River, Baker Brook, Palmer Brook, and other tributaries to the Ammonoosuc River.

The Town of Lincoln is subject to flood flows, generally through one of three streams that flow through the town: the Pemigewasset River, the East Branch Pemigewasset River, and an unnamed tributary to the Pemigewasset River.

2.4 Flood Protection Measures

Seven floodwater retarding structures have been constructed in the Baker River watershed in the Towns of Rumney and Warren; Hildreth Dam was constructed on Berry Brook. It is the only one of the seven which affects the hydrology of the Baker River in the Town of Warren.

These structures control the runoff from approximately 35 percent of the drainage basin of the Baker River upstream of Rumney. Because of the relatively large area controlled by flood control dams, peak flows have been drastically reduced from natural peaks. No additional sites are scheduled for development that would affect the flood potential in the Town of Rumney.

Several upstream reservoirs existing at this time affect flooding along the Connecticut River in the Towns of Lyme and Haverhill. First and Second Connecticut Lakes, Lake Francis, Moore and Comerford Reservoirs, and several smaller reservoirs, with a combined usable capacity of about 14,800,000,000 cubic feet, exert a significant damping effect on flood peaks.

Large amounts of floodwater storage area available along the Mascoma River floodplain located approximately 2,000 feet upstream of the Baltic Mill Dam. This storage area extends up the Mascoma River to West Canaan, approximately 3 miles up Crystal Lake Brook, and the entire length of Goose Pond Brook (two tributary streams located in the Town of Canaan).

Significant flood storage is also incidental to the recreation storage found in Crystal Lake and George Pond in Enfield; Goose Pond, Clark Pond, and Canaan Street Lake located in the Town of Canaan; and Grafton Pond located in the Town of Grafton.

Newfound Lake has a surface area of 6.4 square miles. The New Hampshire Water Resources Board draws the water level down in the fall 3 feet below normal stage. This allows property owners to work on their docks and beaches, and gives incidental protection to shorefront and downstream properties from floods due to fall rains or spring snowmelt. The lake controls are operated throughout the year by the staff of the Water Resources Board to provide the best recreational use of the lake. The operation schedule considers downstream flow capacities so that flood damage along the river, as well as around the lake, can be minimized.

The USACE flood control project, Union Village Dam, located on the Ompompanoosuc River, approximately 6.0 miles above the confluence of Ompompanoosuc and Connecticut Rivers, an upstream tributary of the Connecticut River, was completed in 1950. The reservoir is part of a network of 16 flood control projects in the Connecticut River basin. This project would have reduced peak discharges of historical floods on the Connecticut River at Lebanon by approximately 5 percent, equivalent to a 0.5 foot to 1.0 foot reduction in stage. Flood warning and forecasting services are performed by the National Oceanic and Atmospheric Administration, National Weather Service, which alerts the local news media of possible flooding.

Union Village Dam is the only flood control structure affecting the Town of Hanover. It reduces floodflows on the Connecticut River by approximately 5 percent. In general, flood damage in Hanover is limited by strict residential and floodplain zoning.

There are seven flood control reservoirs within the Pemigewasset River Basin upstream of Holderness. These dams on tributaries of the Baker River were built as part of the Baker River PL-566 Watershed Protection and Flood Prevention Project (U.S. Department of Agriculture, 1963). They are located in Dorchester, Warren, and Wentworth, New Hampshire, and contain 7,774 acre-feet of flood storage.

The Lincoln Levee on the East Branch Pemigewasset River was originally constructed in 1912 by the Franconia Paper Company. The original levee consisted of timber and stone cribbing and earthen fill. The USACE designed and constructed a new levee at the same location in 1960. The new levee utilized structural components of the existing levee, while also supplementing it with bedding stone and reinforcing it with large granite blocks. Some portions were also regraded to increase the height of the levee.

The levee system consists of two segments. The first segment (herein referred to as the primary levee segment) is approximately 1,500 feet long and parallels the East Branch of the Pemigewasset River. This main portion of the levee system was originally constructed of timber and stone cribbing, timber sheeting, and earthen fill. During the 1960 reconstruction, bedding stone was placed in front of the original levee at a 2:1 slope. The slope was then covered by large granite blocks.

The second segment of the levee system (herein referred to as the flanking levee segment) consists of an earthen embankment approximately 200 feet long. This portion of the levee is located at the upstream end (northeast side) of the primary levee segment and runs perpendicular from the primary levee segment northeast until it ties into a steep hillside. This portion of the levee is primarily earthen fill, but also includes a small section with a timber crib and sheeting. During the 1960 reconstruction, this portion of the levee was regraded and raised 2 feet with additional fill.

A sluice gate is located at the intersection of the two levee segments. The original design for the sluice gate was to direct flow from the East Branch of the Pemigewasset River (in conjunction with a diversion structure in the river that has since been demolished) back to a diversion channel behind the levee system that provided flow for the paper mill. The sluice gate was not altered during the reconstruction; however, it is currently buried under sediment and its operational status is unknown.

The levee system has been damaged by multiple storm events since the reconstruction in 1960. Temporary repairs were made to the system after events in 1976, 1993, and 1995. Significant damage occurred during storm events in 2005 and 2011; no repairs were made to the levee system as a result of these events.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Pre-countywide Analyses

Each incorporated community within Grafton County, with the exceptions of the Towns of Alexandria, Ashland, Benton, Bethlehem, Campton, Dorchester, Easton, Ellsworth, Grafton, Hebron, Landaff, Lyman, Monroe, Orange, Piermont, Sugar Hill, Thornton, and Waterville Valley has a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Discharge frequencies for the Ammonoosuc River were developed by statistical analysis of recorded flow data at the USGS gaging station located on the Ammonoosuc River in Bethlehem Junction and from the USDA NRCS Floodplain Management Study for the Towns of Lisbon and Bath (USACE, Floodplain Information: Ammonoosuc River, Bath, New Hampshire). The gaging station has a drainage area of 87.6 square miles.

The gage at Bath has a drainage area of 395.0 square miles with 41 years of record. Statistical analysis of the gaging station data was performed using a log-Pearson Type III distribution. Discharge frequencies at downstream locations along the Ammonoosuc River within the Town of Littleton were considered proportional to those at the gage by respective drainage area ratio to the 0.7 exponential power.

Flood discharge frequencies for the Baker River were taken from the USDA NRCS (formerly SCS) TR-20 study of the Baker River watershed (U.S. Department of Agriculture, 1965) is hydrology incorporates the effects of the seven USDA NRCS flood control structures. For this reason, the floods in the following tables differ significantly from the values for the historical floods that were enumerated in section 2.3. The discharges for the South Branch Baker River, Ore Hill Brook, and Stinson Brook were determined using the USGS regional equations which were based on multiple-regression analyses of gaged data in New Hampshire (U.S. Department of the Interior, Geological Survey, 1978).

Discharge-frequency data for Beede Branch, Clay Brook, Goose Pond Brook, Grant Brook, Hewes Brook, Indian River, Knox River, Lovejoy Brook, Orange Brook, Owl Brook, Pemigewasset River, and Trout Brook studied by detailed methods were developed using Technical Release No. 20, a synthetic rainfall-runoff procedure that relies on regionalized climatological data coupled with the individual stream physical characteristics for input (U.S. Department of Agriculture, 1965).

Discharge-frequency data for Baker River and Sanborn Mill Brook were determined using the USDA NRCS TR-20 computer program. This data was obtained from the USDA NRCS Flood Hazard Analyses for the Town of Plymouth (USACE, 1991).

The discharges for the Cockermouth River and Punch Brook were based on a regional analysis of the drainage area-peak discharge relationships and a standard log-Pearson Type III method analysis (Water Resources Council, 1977) of geographically similar USGS gaged streams within the region.

Baker and Palmer Brooks are tributaries to the Ammonoosuc River within the Town of Littleton. There are no gaging stations on either of these streams. Comparative discharge frequencies were computed using empirical regression equations developed by the USGS for the State of New Hampshire and by prorating the Ammonoosuc River frequency by ratio of respective drainage areas to the 0.7 exponential power (U.S. Department of the Interior, Geological Survey, 1978). The latter method provided 1-percent annual chance flow values approximately 20 to 30 percent higher than the initial method. The area is in the White Mountains, which are subject to flash flooding; therefore, the more conservative higher values were adopted.

The flood frequency-discharge value for the Connecticut River was based on statistical analyses of long-term streamflow records at 2 USGS gaging stations: No. 01138500 (Connecticut River at Wells River, Vermont), and No. 01139000 (Wells River at Wells River, Vermont) (U.S. Department of the Interior, Geological Survey, 1981), and USGS gaging station 01129500. The analyses followed the standard log-Pearson Type III procedures outlined in Bulletin 17B (U.S. Department of the Interior, Geological Survey, 1981). For points on each river other than at gaging stations, the discharges were adjusted by use of drainage area ratios.

A gaging station in Hanover on the Connecticut River at White River Junction, located approximately 3.0 miles downstream from the Town of Hanover, was the principal source of data for defining discharge-frequency relationships for the Connecticut River. The gage has operated since 1911. Values of the 10-, 2-, 1-, and 0.2-percent annual chance annual chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data (Water Resources Council, 1967).

Dells Brook is a tributary to the Ammonoosuc River located at the downstream end of the community. Farr Brook is a tributary to Dells Brook, coming in approximately at the junction of State Route 18 and Interstate Route 93 river crossings within Littleton. Both of these streams are ungaged. Discharge frequencies at the mouth of Dells Brook were computed by the same method as that used for Baker and Palmer Brooks. At upstream locations along Dells and Farr Brooks, discharge frequency values were developed by a straight drainage area ratio with the adopted discharge-frequency values for Dells Brook at its confluence with the Ammonoosuc River.

Discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the East Branch Pemigewasset River were developed by statistical analysis of recorded flow data in the region. USGS gaging stations No. 01074500 (near Lincoln, with a drainage area of 104 square miles and a period record from 1929-1953, 1960, 1968, 1969, 1971, and 1972) and No. 01074520 (at Lincoln, with a drainage area of 115 square miles and a period of record from 1993-1996) were used in the analysis. USGS gaging station No. 01075000, on the Pemigewasset River at Woodstock, New Hampshire, with a drainage area of 193 square miles and 57 years of record, was also used in the analysis.

A two-station gage comparison was performed to extend the record of the East Branch Pemigewasset River gage using the longer-term record at the Pemigewasset River gage. Adopted statistics for the East Branch Pemigewasset River had a mean log of 3.7574 and a standard deviation of 0.2698 with a skew of 0.5. As a check, a statistical analysis of streamflow records for the East Branch Pemigewasset River was performed using annual peak flows in a log-Pearson Type III distribution, as outlined in Bulletin 17B of the U.S. Interagency Advisory Committee on Water Data. The peak discharge relationships from the statistical analysis compared well with those from the adopted two-station comparison method.

Discharges in Lebanon for the Connecticut and Mascoma Rivers for locations other than at the gages were developed on the basis of drainage-area relationships. The modifying effect of Union Village Dam is reflected in the adopted discharges for the Connecticut River.

Discharges for Mascoma Lake are based on statistical analysis of discharge records covering a 59-year period at Mascoma gaging station No. 01150500 (U.S. Department of the Interior, Geological Survey, 1924-1982). Gaging station No. 01145000 operated by the USGS extended to 51 years (U.S. Department of the Interior, Geological Survey, 1981). This analysis followed the standard log-Pearson Type III method (U.S. Department of the Interior, Geological Survey, 1981). Elevations for Mascoma Lake were determined from stage-discharge curves developed by the USDA NRCS at the outlet weir on Mascoma Lake. The 11-year extension back to 1927 was based on a correlation of peak discharges between the Mascoma River gage at West Canaan (drainage area 80.5 square miles) and the Smith River gage No. 01078000 located approximately 18 miles to the east (drainage area 85.8 square miles).

Because Ham Branch is ungaged, discharge-frequency data were developed using a synthetic runoff procedure, developed by the USGS, that relies on regionalized climatological data coupled with the physical characteristics of the stream for input (U.S. Department of the Interior, Geological Survey, 1978).

A gaging station on Mink Brook near Etna, located approximately 5.5 miles upstream of the mouth, has been operated since 1962. Values for the four peak discharges were obtained using a weighted average of the log-Pearson Type III distribution of annual peak flow data from the gage (U.S. Geological Survey, 1974) and the peak discharges calculated from the regional equations developed by the USGS (U.S. Geological Survey, 1962).

Frequency-discharge data for Monahan Brook and Slade Brook were developed by comparison with Mink Brook using the discharge-drainage area ratio formula:

$$\frac{Q1}{Q2} = \left[\frac{A1}{A2}\right]^{0.75}$$

where Q1, Q2 are the discharges at specific locations, and A1, A2 are the drainage areas at these locations (Johnstone, 1949).

Peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods of the Connecticut River, Monahan Brook, Mink Brook, and Slade Brook within the Town of Hanover and maximum known peak discharges are shown in Figure 1.

Flood elevations for the Newfound River at the Upper IPC Dam pond were determined by manual computation using the weir flow equation $Q = CLH^{3/2}$.

For Newfound Lake, the following operational situation of the lake outlet structure was assumed: the gates are closed and the stop-logs are at normal summer level with a base flow of 200 cfs when the flood occurs. All gates are then opened and stop-logs pulled with the assumption that the gate operator is protecting shorefront property. This condition maximizes downstream flow for a given flood event.

A second situation was studied for Newfound Lake that assumes that the lake is at a summertime level of 587.2 feet elevation and the base flow is less than 50 cfs. It assumes the gate operator cannot open the gates and pull the stop-logs at the dam, thereby maximizing flood elevations of the lake. The flood elevations for the 10-, 2, 1-, and 0.2-percent annual chance floods were computed using the USACE HEC-1 flood hydrographic package and the USACE HEC-2 step-backwater computer program (USACE, 1990; USACE, 1991).

Discharge-frequency data for Pemigewasset River were developed by the NH GRANIT for the Town of Plymouth, New Hampshire, Flood Hazard Analysis. The 100-year discharges for the Pemigewasset River were based on statistical analyses of long-term streamflow records at USGS gaging stations No. 01074500 (East Branch Pemigewasset River near Lincoln), No. 01075000 (Pemigewasset River at Woodstock), and No. 01076500 (Pemigewasset River at Plymouth). The analyses followed the standard log-Pearson Type III method as outlined in USGS Bulletin 17B (U.S. Department of the Interior, Geological Survey, 1981). For points on each river other than at the gaging stations, the discharges were adjusted by use of drainage-area ratios.Peak discharges for the Pemigewasset River at intermediate sites in the town were established by adjusting the peak discharges computed for the Plymouth gage using the following formula:

$$Q=Q_g\ (A/A_g)^{0.5}$$

where Q is the discharge at the intermediate site, Q_g is the discharge as computed for the Plymouth gaging station, A and A_g are the drainage areas at the intermediate site and the gaging station, respectively. The exponent, 0.5, was estimated using available flood data (U.S. Department of the Interior, Geological Survey, 1976).

The 1-percent annual chance flood elevation for Eastman Pond was determined from a reservoir routing analysis. An inflow hydrograph was computed using data from a USACE dam inspection of the outlet structure (USACE, 1979). The hydrograph peak was computed using the procedure outlined in Section 3.1 of this report. The resultant hydrograph was routed through Eastman Pond using the modified Puls method (Linsey, R. K., 1982). The starting pond elevation was based on stead state, mean flow conditions.

February 20, 2008 Countywide Analyses

For the February 20, 2008 countywide FIS report, the 1-percent annual chance discharges for Canaan Street Lake and Mirror Lake were determined using the USDA NRCS TR-20 rainfall-runoff model. Model input consisted of the 1-percent annual chance rainfall at 1-, 2-, and 3-day durations, and watershed, stream, and reservoir routing characteristics (e.g., drainage area, slope, storage). Antecedent runoff conditions were assumed to be average. The 1-percent annual chance rainfall quantities were estimated from regional maps of precipitation extremes (Wilks and Cember, 1993), and adjusted to allow for a random time window (i.e., 24-hour rainfall instead of 1-day rainfall measured at a fixed daily time) using the conversion factors given by Wilks and Cember (1993). The rainfall duration producing the highest discharge was considered to be the 1-percent annual chance flood.

The 1% annual chance discharge for Squam Lake was determined using the USDA NRCS TR-20 rainfall-runoff model. Model input consisted of the 1-percent annual chance rainfall at 1-, 2-, 5-, 10-, 20-, 30-, and 40-day durations, and watershed, stream, and reservoir routing characteristics (e.g., drainage area, slope, storage). Antecedent runoff conditions were assumed to be average. The 1-percent annual chance rainfall quantities were estimated from regional maps of precipitation extremes (Wilks and Cember, 1993) for 1-, 2-, 5-, and 10-day durations, and estimated for 20, 30, and 40 days by assuming a log-linear relationship between depth and duration (Hershfield, 1961). Rainfall depth was adjusted to allow for a random time window (i.e., 24-hour rainfall instead of 1-day rainfall measured at a fixed daily time) using the conversion factors given by Wilks and Cember (1993). The 1-percent annual chance rainfall was adjusted for drainage area following the graphed relationships given by Hershfield (Hershfield, 1961) to convert point-rainfall depths to areal depths. The rainfall duration producing the highest discharge was considered to be the 1-percent annual chance flood.

Lincoln Levee System Update

No new hydrologic analyses were conducted for the Lincoln Levee System Update.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 5, "Summary of Discharges." Drainage area-peak discharge relationships not presented in Table 8 are presented in Figure 1, "Frequency-Discharge, Drainage Area Curves."

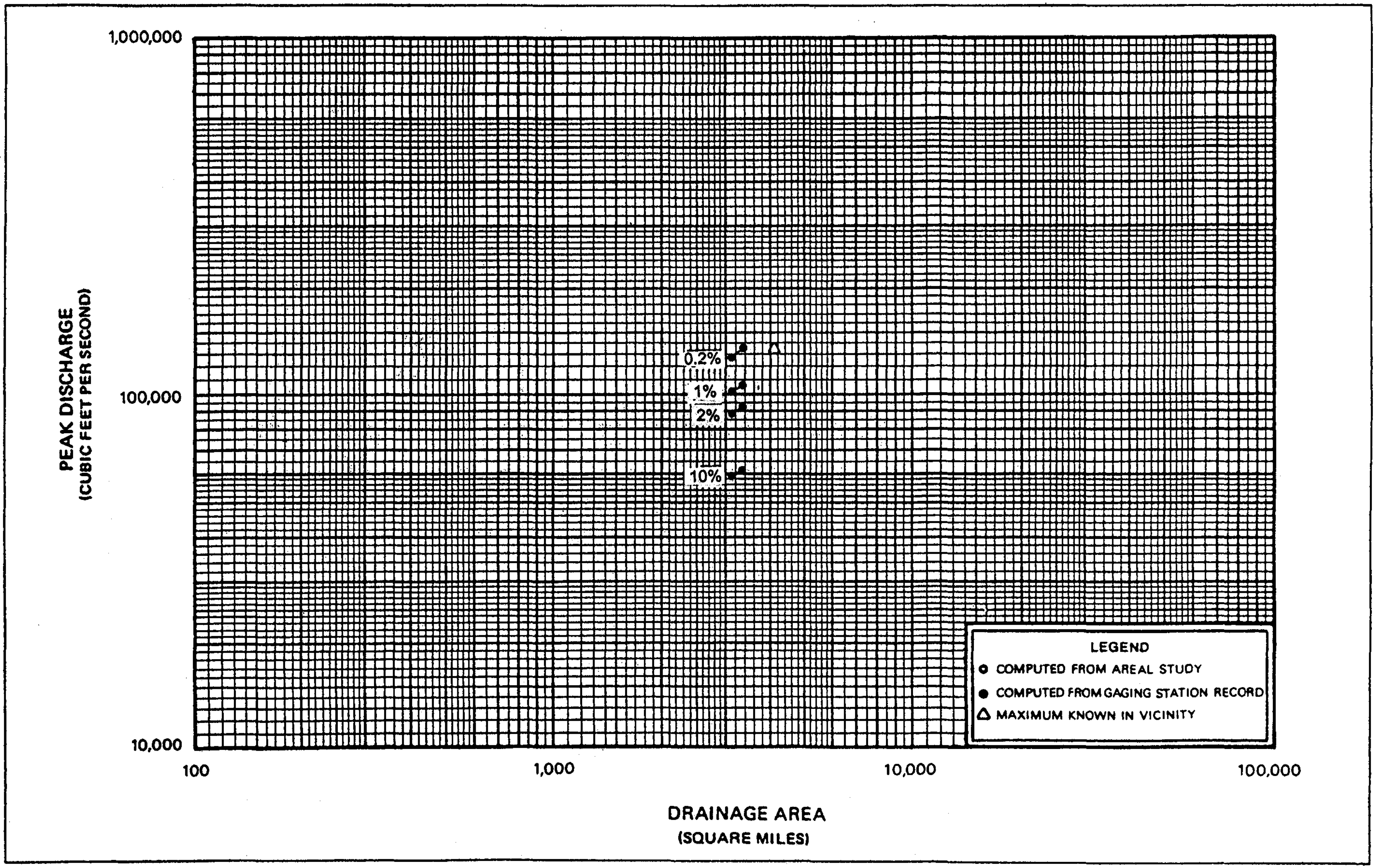


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

CONNECTICUT RIVER in Town of Hanover

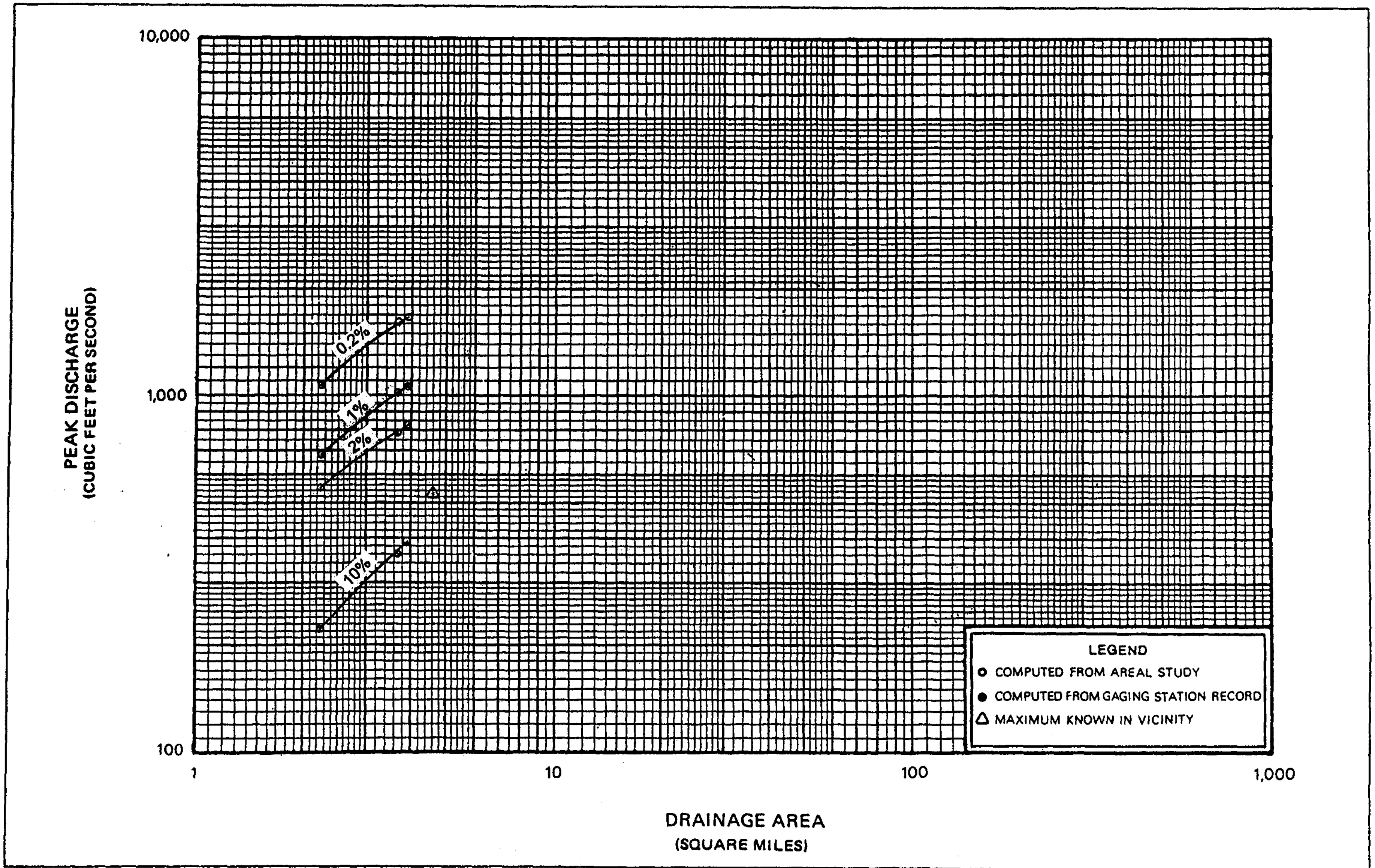


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

CONNECTICUT RIVER in Town of Hanover

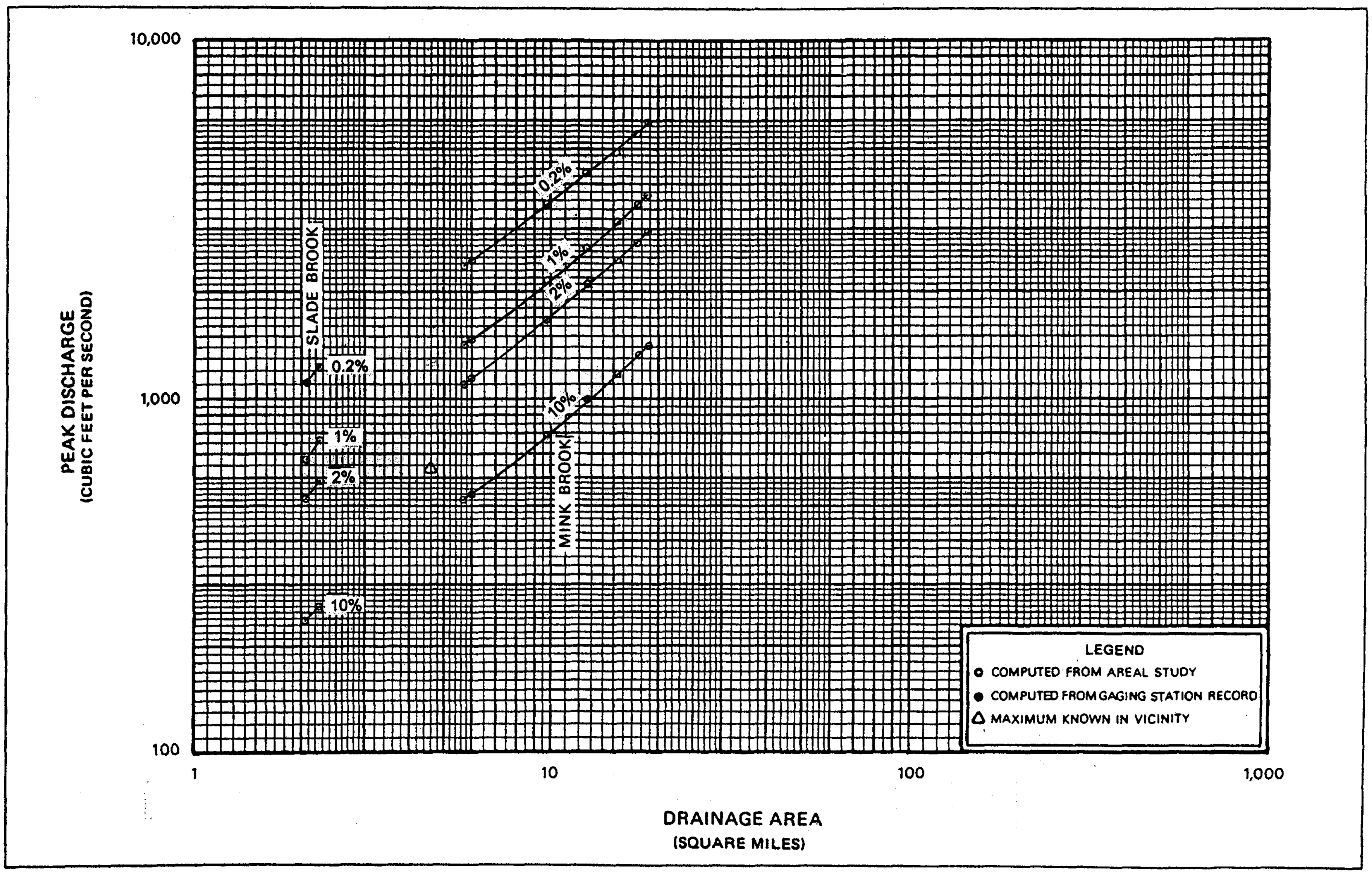


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

SLADE BROOK – MINK BROOK in Town of Hanover

TABLE 5 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
AMMONOOSUC RIVER					
At USGS gaging station near Bath	395	*	*	50,000	*
At the downstream corporate limits of Lisbon	304	16,600	25,550	29,800	41,950
Approximately 1,500 feet upstream of the corporate limits of Lisbon	288	16,150	24,750	28,800	40,600
At State Route 302	257	14,950	23,050	26,750	37,900
At downstream corporate limits of Littleton	141.2	10,460	16,010	18,795	26,450
At confluence of Palmer Brook	128.4	9,790	14,980	17,585	24,750
At upstream corporate limits of Littleton	117.8	9,215	14,100	16,555	23,300
BAKER BROOK					
At confluence with Ammonoosuc River	5.4	1,065	1,630	1,915	2,695
BAKER RIVER					
At U.S. Route 3	214	9,600	14,500	16,900	22,400
At Smith Bridge Road	208	9,600	14,500	16,900	22,400
At Stinson Lake Road	159	8,200	12,800	14,400	19,000
Upstream from the confluence of the South Branch Baker River	92	7,700	12,100	13,600	18,000
At Main Street	64	7,150	11,300	12,700	16,950
At State Route 25 near Warren Center	64	7,150	11,300	12,700	16,950
At Moosilauke Carriage Road	36	6,240	9,940	11,200	14,900
BEEDE BROOK					
At School Road	2.2	540	985	1,210	1,850
At Perch Pond Road	1.6	425	770	950	1,450
CANAAN STREET LAKE	2.17	*	*	88	*
CLAY BROOK					
At North Thetford Road	*	*	*	1,820	*

*Data not available

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
COCKERMOUTH RIVER					
At North Groton Road	22.1	3,120	6,610	9,000	18,500
At confluence of Punch Brook	16.7	2,520	5,340	7,290	15,000
CONNECTICUT RIVER					
At downstream corporate limits of Lebanon	4,300	72,000	108,000	125,000	157,000
Upstream of the White River	3,380	62,600	94,000	108,000	135,000
At downstream corporate limits of Haverhill	2,644.0	*	*	80,300	*
At USGS Gaging Station No. 01138500	2,644.0	*	*	72,200	*
At USGS Gaging Station No. 01129500	799.0	*	*	29,800	*
DELLS BROOK					
At confluence with Ammonoosuc River	4.4	925	1,410	1,660	2,335
At confluence with Farr Brook	2.7	570	865	1,020	1,435
Approximately 3,500 feet upstream of State Route 18	1.8	380	580	680	955
EAST BRANCH PEMIGEWASSET RIVER					
At USGS gaging station 01074520 at Lincoln	115	13,000	24,000	30,300	50,000
FARR BROOK					
At confluence with Dells Brook	1.2	250	385	455	640
GOOSE POND BROOK					
At confluence with Mascoma River	20.5	430	770	935	1,350
At Goose Pond Dam	15.7	185	385	490	780
GRANT BROOK					
At State Route 10	13.6	*	*	2,770	*
At Pikes Brook	11.2	*	*	1,890	*

*Data not available

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
HAM BRANCH					
At its confluence with the Gale River	30	*	*	4,100	*
At the upstream corporate limits of Town of Franconia	19	*	*	3,450	*
HEWES BROOK					
At State Route 10	11.00	*	*	885	*
At Bliss Road	5.44	*	*	570	*
INDIAN RIVER					
At confluence with Mascoma River	44.4	2,030	3,500	4,135	6,550
At U.S. Route 4 (east of Canaan Village)	32.6	1,530	2,700	3,195	5,430
At upstream corporate limits of Canaan	5.5	575	1,160	1,460	2,230
KNOX RIVER					
At confluence with Mascoma Lake	7.87	755	1,320	1,590	2,325
At State Route 4A	5.56	136	270	345	520
LOVEJOY BROOK					
At confluence with Mascoma River	7.12	680	1,130	1,300	1,720
MASCOMA RIVER					
At confluence with the Connecticut River	194	3,500	5,750	7,000	10,000
At Mascoma Lake Dam	153.0	3,275	4,875	5,650	7,680
At confluence with Mascoma Lake	134.0	3,100	4,815	5,665	7,970
At downstream corporate limits of Canaan	120.4	3,100	4,815	5,665	7,970
At USGS gage No. 01145000 in West Canaan	80.5	3,100	4,815	5,665	7,970
At confluence with Indian River	33.4	1,050	1,950	2,400	3,600
Approximately 2,000 feet upstream of Lashua Road	19.8	700	1,390	1,745	2,665
NEWFOUND RIVER					
At South Main Street	98	2,100	2,500	2,660	3,000
ORANGE BROOK					
At confluence with Indian River	8.5	1,700	3,070	3,750	5,410

*Data not available

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
ORE HILL BROOK					
At Lund Road	10	1,710	3,640	4,950	10,200
OWL BROOK					
At State Route 175	6.8	930	1,720	2,150	3,320
At Driveway Bridge	3.4	380	740	940	1,500
At Perch Pond Bridge	1.5	215	420	530	860
PALMER BROOK					
At confluence with Ammonoosuc River	3.8	835	1,275	1,500	2,105
PEMIGEWASSET RIVER					
At Ayers Island Dam in Bristol	746	*	*	69,000	*
At the upstream corporate limits	633	*	*	63,600	*
At the USGS gaging station in Plymouth	622	*	*	63,000	*
At northern corporate limits of Holderness	408	26,000	39,200	45,600	60,600
At Bridge Street	622	35,000	53,500	62,000	82,700
At southern corporate limits of Holderness	625	35,000	53,500	62,000	82,700
At Interstate Route 93	406	26,000	39,200	45,600	60,600
At downstream corporate limits of Woodstock	223	*	*	53,300	*
At USGS gage No. 01075000 in Woodstock	193	*	*	47,700	*
At upstream corporate limits of Woodstock	34	*	*	12,400	*
PUNCH BROOK					
At North Groton Road	5.26	880	2,270	3,300	7,740
SANBORN MILL BROOK					
At State Route 25	7	1,720	2,500	2,900	3,800
At Yeaton Road	5	1,500	2,200	2,500	3,250
SOUTH BRANCH BAKER RIVER					
At State Route 25	27	3,700	6,900	8,800	14,700

*Data not available

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SQUAM LAKE	58.2	*	*	302	*
STINSON BROOK					
At Quincy Street	19	2,600	6,000	8,200	16,500
TROUT BROOK					
At Post Pond	14.00	*	*	2,620	*
At State Route 10	11.40	*	*	2,120	*
At Pinnacle Road	4.940	*	*	962	*

*Data not available

The stillwater elevations have been determined for the 10-. 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods and are summarized in Table 6, "Summary of Stillwater Elevations."

TABLE 6 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD[1]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
CANAAN STREET LAKE				
Entire shoreline	*	*	1,145.8	*
EASTMAN POND				
Entire shoreline within city	*	*	1,110.1	*
MASCOMA LAKE				
Immediately upstream of Mascoma Lake Dam	752.5	753.7	754.2	755.3
NEWFOUND RIVER-UPPER IPC DAM POND				
At the Upper IPC Dam	555.7	556.3	556.5	557.1
NEWFOUND LAKE				
Entire shoreline	589.2	590.2	590.8	592.4
SQUAM LAKE				
Entire shoreline within county	*	*	565.3	*

[1] North American Vertical Datum 1929

*Data not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Pre-countywide Analyses

Cross sections for the backwater analysis of the Baker River, Cockermouth River, Ore Hill Brook, South Branch Baker River, and Stinson Brook were obtained from aerial photographs flown in May 1980 at a scale of 1"=800' (Moore Survey and Mapping, 1980).

Additional cross-sectional data for the Connecticut River were obtained from topographic maps (U.S. Department of the Interior, Geological Survey, 1973, et cetera).

Cross sections for the backwater analyses for the Ammonoosuc River, Baker Brook, Dells Brook, Farr Brook, and Palmer Brook studied by detailed methods were obtained from topographic maps compiled by photogrammetric methods (USACE, 1984).

Cross-section data for Clay Brook, Grant Brook, Hewes Brook, and Trout Brook were obtained by field measurements and were located using standard USGS guidelines.

Cross sections for the backwater analyses for the Goose Pond Brook, Indian River, Mascoma River, and Orange Brook studied by detailed methods were obtained from aerial photographs at a scale of 1:14,400 with a contour interval of 4 feet (Aerial Survey and Photos, Inc., 1985).

The valley portions of the cross-section data for the Connecticut River, Mink Brook, Monahan Brook, and Slade Brook were obtained photogrammetrically; the below-water portions were obtained by field measurement. Bridge plans were utilized to obtain elevation data and structural geometry. All bridges for which plans were unavailable or out of date were surveyed.

Most of the survey data for the Ammonoosuc River was gathered during planning for a PL-566 small watershed project for the Ammonoosuc River in 1956-57.

Water-surface elevations for Ammonoosuc River, Beede Brook, East Branch Pemigewasset River, Goose Pond Brook, Indian River, Ham Branch, Knox River, Lovejoy Branch, Mascoma River, Newfound River, Orange Brook, Owl Brook, and

Pemigewasset River were computed through use of the USDA NRCS WSP-2 step-backwater computer program (U.S. Department of Agriculture, Geological Survey, 1965).

Water-surface elevations of floods of the selected recurrence intervals for Pemigewasset River were computed using the WSPRO step-backwater computer program (Federal Highway Administration, 1990; Federal Highway Administration, 1986). Results from the step-backwater modeling were compared to historic data available from the March 1936 flood as part of calibration (U.S. Department of the Interior, 1976). There is reasonable agreement between the historic and computed data.

The 1-percent annual chance flood elevations for the Connecticut River in the Town of Lyme were based upon high-water marks of notable past floods located along the Connecticut River in Lyme. The high-water marks have been published as flood-crest data in USGS Water-Supply Paper 798, "The Floods of March 1936" (U.S. Department of the Interior, Geological Survey, 1976). Streambed elevations plotted on the profiles were determined from topographic maps (U.S. Department of the Interior, Geological Survey, 1976).

Water-surface elevations of floods of the selected recurrence intervals for Baker River, Ore Hill Brook, and Stinson Brook in the Town of Warren were computed through use of the USACE HEC-2 step-backwater computer program (USACE, 1968).

Starting water-surface elevations for the Baker River were taken from known elevations in the FIS for the Town of Wentworth (FEMA, 1982). Starting water-surface elevations for the Baker River were taken from known elevations in the Town of Plymouth FIS (FEMA, 2001).

Starting water-surface elevations for Ammonoosuc River, Baker Brook, Cockermouth River, Connecticut River, Dells Brook, East Branch Pemigewasset River, Farr Brook, Mascoma River, Mink Brook, Monahan Brook, Ore Hill Brook, Palmer Brook, Pemigewasset River, Sanborn Mill Brook, Slade Brook, South Branch Baker River, and Stinson Brook were calculated using the slope/area method.

In the 1990 FIS for the City of Lebanon, water-surface elevations for floods on the Mascoma River, from its confluence with the Connecticut River to the downstream side of the rebuilt Grafton County Power Dam No. 3, were computed using the USGS J635 step-backwater computer program (U.S. Department of the Interior, Geological Survey, 1977). In the 1990 FIS for the City of Lebanon, starting water-surface elevations for the Connecticut River were taken from the FIS for the Town of Hartland, Vermont, in which an ice-jam analysis was performed (FEMA, 1988). Water-surface elevations on the upstream side of the Wilder Dam spillway were obtained from the New England Power Service Company.

The starting water-surface elevations for the Ammonoosuc River were obtained from the FIS for the Town of Lisbon (FEMA, 1986). The starting elevations for Baker Brook were taken at its confluence with the Ammonoosuc River. Starting water-surface elevations were taken from the FIS for the Town of Haverhill (FEMA, 1990).

Starting water-surface elevations for the Mascoma River at its confluence with the Connecticut River were taken from the flood profiles computed for the Connecticut River. In the City of Lebanon, flood peaks on the Mascoma River for the 10-, 2-, 1-, and 0.2-percent annual chance annual chance frequency floods were found to coincide with the 1-, 5-, 25-, and 50-year frequency floods, respectively, on the Connecticut River.

Starting water-surface elevations for the Baker River were taken from known elevations in the FIS for the Town of Rumney. Starting water-surface elevations for the South Branch Baker River were calculated using critical depth. Starting water-surface elevations for Newfound River were based on the assumption of critical depth at a point 20 feet below the South Main Street bridge. Starting water-surface elevations for Goose Pond Brook, Lovejoy Brook, and Mascoma River were determined by computing critical depth at the Baltic Mill Dam on the Mascoma River. Water-surface profiles were computed upstream to the confluence with Lovejoy Brook using Lovejoy Brook flows only.

Known water-surface elevations based on preliminary critical depth calculations were used for starting water-surface elevations on Punch Brook.

Starting water-surface elevations for Beede Brook were developed from the profiles for Owl Brook.

Flood elevations on the Connecticut River at the downstream limit of the study are affected by Wilder Dam, which is located approximately 1.75 miles below the Town of Hanover. Starting water-surface elevations for the Connecticut River were based on the pool elevations that would result from the current procedures used by the New England Power Service Company in operating the dam.

A starting water-surface elevation for Ham Branch, at its confluence with the Gale River was determined by computing a water-surface profile beginning at a point approximately 0.5 mile downstream on the Gale River, using estimates of the 1-percent annual chance annual chance discharge (obtained with the method described in Section 3.1) and a surveyed hydraulic gradient.

The flood elevations for Girl Brook, Great Hollow Brook, a tributary to Great Hollow Brook, Hewes Brook, Lovejoy Brook, Pressey Brook, and Scales Brook were determined by approximate methods using a stage-drainage area relationship.

Starting water-surface elevations were obtained from a WSP-2 model of the Pemigewasset River developed by the USDA NRCS in 1978.

For Clay Brook, Grant Brook, Hewes Brook, and Trout Brook, starting water-surface elevations were determined from normal depth computations at their downstream limits.

Starting water-surface elevations for the Mascoma and Knox Rivers were obtained from the normal recreation pool elevations of 750 feet on Mascoma Lake.

Starting water-surface elevations for Pemigewasset River at the Bridgewater-Bristol corporate limits were computed from step-backwater modeling from the Ayers Island Dam in Bristol. Starting water-surface elevations for Pemigewasset River at the Ayers Island Dam were taken from a rating curve developed by Public Service Company of New Hampshire of Manchester, New Hampshire (Public Service Company of New Hampshire, 1993).

Starting water-surface elevations for the Pemigewasset River were obtained from the Town of Bridgewater FIS dated June 4, 1996 (FEMA, 1996).

For the East Branch Pemigewasset River in the Town of Lincoln, water-surface elevations were computed using the USACE HEC-2 step-backwater computer program (USACE, 1991). Starting water-surface elevations were calculated using the slope/area method.

For the Pemigewasset River and East Branch Pemigewasset River, starting water-surface elevations were determined by computing a water-surface profile starting with the 1-percent annual chance elevation used by the New Hampshire Highway Department for designing Cross Road bridge, located 3 miles downstream in Thornton. The results of the water-surface computations are tabulated for the selected cross sections for each stream segment.

An area of sheet flow exists to the east of cross section P; this is due to the overtopping of the ridge of land that forms the east abutment to a run-of-the-river dam on the Pemigewasset River. This flow rejoins the river after running down the back side of this ridge. The average depth of the sheet flow (two feet) was calculated by dividing the total area of overland flow by its top width. The area of overland flow was computed by measuring the area within the shape formed by superimposing the 1-percent annual chance flood profile (from the dam to the corporate limits) over the surveyed land profile of the ridge that runs parallel to the river.

Starting water-surface elevations for the Indian River and Orange Brook in the Town of Canaan were the elevations at the stream confluences due to coincident flow with the Mascoma and Indian Rivers, respectively, during the flood of equal frequency.

At West Canaan, flood flows in the Mascoma River divide with a portion being diverted over South Road into Crystal Lake Brook. The quantity of flow diverted was subtracted from the flow within the Mascoma River in order to model backwater conditions present during flood events. Trial and error computer runs were made until the downstream Mascoma River flow plus the diverted flow equaled the upstream inflow to the diversion location.

The Indian River's flood flows follow two paths to the Mascoma River near their confluences. The majority of major floods divert to the south of the railroad fill at the above location prior to joining the Mascoma River downstream of the second railroad bridge to the west of Potato Road. Trial and error water-surface profiles were computed along both paths until the discharge components following each route created equal elevations at the entrance to the diversion.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n"), used in the hydraulic computations, were chosen by engineering judgment and based on field observations of the river and floodplain area for the Baker River, Clay Brook, Cockermouth River, Connecticut River, East Branch Pemigewasset River, Goose Pond Brook, Grant Brook, Hewes Brook, Indian River, Mascoma River, Orange Brook, Pemigewasset River, Stinson Brook, and Trout Brook.

For the Baker River, Pemigewasset River, and Sanborn Brook, in the Town of Plymouth, roughness coefficients (Manning's "n") for the hydraulic computations were estimated by field inspection at each cross section. Observations were made of channel bottom and bank conditions, amount of flow obstruction, channel meanders, and shape variation. The information gathered was analyzed using standard procedures as outlined in the USGS Water-Supply Paper 1849 (U.S. Department of the Interior, Geological Survey, 1967).

Observations for Beede Brook, Owl Brook, and Pemigewasset River in the Town of Holderness were made of channel bottom and bank conditions, amount of flow obstruction, and channel meanders and shape variation. Information gathered was analyzed using standard procedures (U.S. Department of the Interior, Geological Survey, 1967).

For the Ammonoosuc River, Baker Brook, Dells Brook, Farr Brook, and Palmer Brook in the Town of Littleton, roughness coefficients (Manning's "n") used in the hydraulic computations were determined on the basis of field inspection, analysis of photographs, and engineering judgment.

Roughness coefficients (Manning's "n") for the Newfound River were estimated by field inspection at each cross section.

February 20, 2008 Countywide Analyses

For the February 20, 2008 countywide FIS, cross sections at the outlet of Canaan Street Lake were measured by field survey. The dam at Canaan Street Lake was also field surveyed to obtain elevation data and structural geometry.

Water-surface elevations of the 1-percent annual chance flood at Canaan Street Lake were determined from the peak lake elevations computed by the reservoir routing routine in the USDA NRCS TR-20 computer program. The elevation-discharge rating for the lake outlet, which is used in the TR-20 reservoir routing, was determined using the USACE HEC-RAS computer program by calculating water-surface elevations for a range of discharge values. At Canaan Street Lake, outflow divides between the dam weir and a spillway when the lake elevation tops the spillway crest. The total discharge was split between the weir and spillway using the energy equation computation.

Because of the divided flow at Canaan Street Lake, starting water-surface elevations here were determined at two locations downstream of the flow junction: at the dam weir using the weir-flow equation, and at the spillway by computing normal depth.

The 1-percent annual chance discharge and water-surface elevation at Canaan Street Lake are dependent on the available flood storage in the lake, which is a function of the lake elevation at the outset of the 1-percent annual chance rainfall event. The starting lake elevation in the flood routing computations was determined from the lake elevation-discharge ratings using a discharge value equal to the mean annual discharge, which in turn was estimated from a regional map of average annual runoff (Knox and Nordenson, 1955).

Channel roughness factors (Manning's "n") were chosen by engineering judgment. The highest "n" value for the Canaan Street Lake outlet was at the crest of the earthen spillway, which is covered by dense sapling growth.

Discharge from Squam Lake is regulated by Squam Lake dam, which was field surveyed to obtain elevation data and structural geometry. Additional information about the configuration and operation of this hydroelectric power generating dam was obtained from the Ashland Electric Department and the Dam Bureau of the New Hampshire Department of Environmental Services.

Water-surface elevation of the 1-percent annual chance flood at Squam Lake was determined from the peak lake elevation computed by the reservoir routing routine in the USDA NRCS TR-20 computer program. The elevation-discharge rating for Squam Lake dam, which is used in the TR-20 reservoir routing, was determined using standard weir-flow and gated-flow hydraulic equations. Discharge coefficients were selected from graphs presented by Hulsing (1967) for weir flow, and from tables given by Bodhaine (1968) for orifice flow.

The discharge at a given elevation is dependent on the settings of the dam gates and hydroelectric turbines, and a configuration therefore had to be chosen for making the discharge calculations. The assumed configuration was sluice gates closed, turbines off, and stoplogs in place for normal summer pool elevation.

The 1-percent annual chance discharge and water-surface elevation at Squam Lake is dependent on the available flood storage in the lake, which is a function of the lake elevation at the outset of the 1-percent annual chance rainfall event. The normal operating water level of Squam Lake varies between 10.0 feet in winter and 12.5 feet in summer (dam datum). The maximum summer operating level of 12.5 feet (562.23 feet NGVD) was used as the starting lake elevation in the flood routing computations.

Lincoln Levee System Update

A new detailed analysis was conducted for a portion of the effective detailed reach of the East Branch Pemigewasset River surrounding the Lincoln Levee System in March 2017. The analysis was based on the conclusions reported in the Analysis and Mapping Plan, Lincoln LAMP Project for the Town of Lincoln, Grafton County, NH (FEMA 2016). The plan recommended that the natural valley scenario be utilized based on the data available for the levee system at the time of the report. The natural valley scenario, which dictates conveyance on both sides of the levee, necessitated that the overflow channel located behind the study also be analyzed.

Field surveys were performed in 2015 for below-water, bridge/culvert, levee, and channel cross-sections, including on both the main channel of the East Branch Pemigewasset River and the overflow channel, and at all significant structures, including on the two levee reaches comprising the Lincoln Levee System. HEC-GeoRAS v.10 (USACE, 2012) was used to convert the stream centerline and additional cross-section data created in ArcGIS v.10 (Esri, 2010) for use in HEC-RAS v. 4.1.0 (USACE, 2010). HEC-GeoRAS utilized a Digital Elevation Model (DEM) produced for the Lincoln area to develop the overbank portions of the model cross-sections. The overbank DEM was produced using two sources. The first source included 2-foot contours developed from surveys conducted in 2000 and further refined in 2007. The extents of this topographic data included the project area, except for portions of the south bank of the East Branch Pemigewasset River. Overbank data for the southern bank was supplemented using a 10-meter DEM available from the United States Geological Survey (USGS) National Elevation Dataset (NED), as well as the survey data collected as part of March 2017 analysis.

After the initial hydraulic calculations were completed, warnings presented by the HEC-RAS model were reviewed. The results were assessed for validity, accuracy, and appropriate engineering practices. Some of the areas of concern included: critical water surface elevations (WSEL) calculations, WSEL differences between adjacent cross-sections, and correct usage of ineffective flow areas. After the initial areas of concern were addressed, the HEC-RAS models were recalculated. All remaining warnings generated by HEC-RAS were reviewed and judged acceptable for the final models.

A floodway run was completed on the detailed reaches using the maximum surcharge of 1.0 feet allowed in New Hampshire.

The starting boundary condition for all water surface profiles on the East Branch Pemigewasset River tie into the effective detailed study at lettered cross-section D. The starting boundary condition for the overflow channel was set equal to the water surface elevation of the East Branch Pemigewasset River at the confluence area. A lateral structure was added at the upstream end of the East Branch Pemigewasset River and optimized in HEC-RAS to determine the amount of flow that diverges away from the mainstem and enters the overflow channel.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 7, "Manning's "n" Values."

TABLE 7 - MANNING'S "n" VALUES

Stream	Channel "n"	Overbank "n"
Ammonoosuc River	0.045	0.060
Baker Brook	0.025-0.030	0.060
Baker River	0.030-0.050	0.050-0.250
Beede Brook	0.043-0.050	0.050-0.120
Canaan Street Lake outlet	0.035-0.140	0.035-0.140
Clay Brook	0.020	0.070
Cockermouth River	0.035-0.070	0.055-0.250
Connecticut River	0.025-0.050	0.040-0.100
Dells Brook	0.030-0.035	0.060-0.065
East Branch Pemigewasset River[1]	0.035	0.045-0.120
East Branch Pemigewasset River Overflow[1]	0.045	0.080-0.120
Farr Brook	0.030-0.035	0.060-0.065
Goose Pond Brook	0.035-0.070	0.060-0.250
Grant Brook	0.040	0.070
Ham Branch	0.043-0.052	0.060-0.150
Hewes Brook	0.040	0.065
Indian River	0.030-0.065	0.060-0.150
Knox River	0.030-0.070	0.060-0.120
Lovejoy Brook	0.040-0.100	0.060-0.120
Mascoma River	0.030-0.065	0.040-0.150
Mink Brook	0.025-0.050	0.040-0.100
Monahan Brook	0.025-0.050	0.040-0.100

[1] Revised for Lincoln Levee System Update

TABLE 7 - MANNING'S "n" VALUES - continued

Stream	Channel "n"	Overbank "n"
Newfound River	0.040-0.055	0.020-0.150
Orange Brook	0.045-0.050	0.070-0.120
Ore Hill Brook	0.025-0.060	0.100-0.250
Owl Brook	0.043-0.050	0.050-0.120
Palmer Brook	0.045	0.060
Pemigewasset River	0.030-0.055	0.040-0.160
Punch Brook	0.040	0.080-0.200
Sanborn Mill Brook	0.045-0.080	0.030-0.120
Slade Brook	0.025-0.050	0.040-0.100
South Branch Baker River	0.040	0.047-0.150
Stinson Brook	0.040-0.045	0.080-0.150
Trout Brook	0.020	0.070

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

Flood elevations shown in this FIS report on FIRM panels 33009C0290F, 33009C0310F, 33009C0435F, 33009C0440F, 33009C0441F, 33009C0445F, 33009C0455F, and 33009C0465F are referenced to NAVD 88. Structure and ground elevations on those FIRM panels, therefore, be referenced to NAVD 88. All other flood elevations shown in this FIS report and on the other FIRM panels are referenced to NGVD 29. Structure and ground elevations outside of the FIRMs referenced above must, therefore, be referenced to NGVD 29. It is important to note that adjacent communities may be referenced to NAVD 88. This may result in differences in base flood elevations across the corporate limits between the communities. Ground, structure, and flood elevations may be compared and/or referenced to NAVD 88 by applying a standard conversion factor. **The conversion factor for Grafton County from NGVD 29 to NAVD 88 is -0.3 foot, and from NAVD 88 to NGVD 29 is +0.3 foot.**

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using aerial photographs at a scale of 1"=400' (U.S. Department of Agriculture, Soil Conservation Service, 1983); using topographic maps at a scale of 1:24,000, contour intervals 5, 10, 20, 40 feet (U.S. Department of the Interior, 1925, 1964, 1967, 1973, 1976, 1980, 1984 and 1987); at a scale of 1:4,800 with a contour intervals of 4 or 5 feet (U.S. Department of Interior, Geological Survey, 1967) at a scale of 1:62,500 with a contour interval of 20 feet (U.S. Department of Interior, Geological Survey, 1927, 1935 1953, and 1956), and at a scale of 1:4,800 contour interval 5 feet (Moore Survey and Mapping, 1980); or maps displaying alluvial soils as mapped (U.S. Department of Agriculture, Soil Conservation Service, unpublished; U.S. Department of Agriculture, Soil Conservation Service, 1939).

Boundaries for the Mascoma River were delineated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (City of Lebanon, 1984). Boundaries for the Connecticut River were delineated using topographic maps at a scale of 1:24,000 with a contour of 5 feet (Lockwood Support Services, 1985). Boundaries for Newfound Lake were delineated using topographic maps at a scale of 1:24,000 with a contour of 20 feet (U.S. Department of the Interior, Geological Survey, 1925).

For the February 20, 2008 countywide FIS, for Canaan Street Lake, the 1-percent annual chance floodplain boundary was delineated using USGS topographic map at a scale of 1:25,000, enlarged to a scale of 1:12,000, with a contour interval of 6 meters (U.S. Department of the Interior, 1984). The 1-percent annual chance floodplain boundary for Squam Lake was delineated using USGS topographic maps at a scale of 1:24,000, enlarged to a scale of 1:12,000, with a contour interval of 20 feet or 40 feet (U.S. Department of the Interior, 1980 and 1987).

For the Lincoln Levee System update, the 1- and 0.2-percent annual chance floodplain boundary was delineated for the East Branch Pemigewasset River using 2-foot contours developed from surveys conducted in 2000 and further refined in 2007. The extents of this topographic data did not include portions of the south bank of the East Branch Pemigewasset River. Overbank data for the southern bank was supplemented using a 10-meter DEM available from the United States Geological Survey (USGS) National Elevation Dataset (NED), as well as the survey data collected for the study.

For the flooding sources studied by approximate methods, the boundaries of the 1-percent annual chance floodplains were delineated using the Flood Hazard Boundary Map (FHBM) for the Towns of Bath (U.S. Department of Housing and Urban Development, 1976); Bridgewater (U.S. Department of Housing and Urban Development, 1976); Bristol (U.S. Department of Housing and Urban Development, 1975), Canaan (U.S. Department of Housing and Urban Development, 1977); Enfield (U.S. Department of Housing and Urban Development, 1976); Franconia (U.S. Department of Housing and Urban Development, 1977); (U.S. Department of Housing and Urban Development, 1976); Hanover (U.S. Department of Housing and Urban Development, 1974); Holderness (U.S. Department of Housing and Urban Development, 1976); Lyme (U.S. Department of Housing and Urban Development, 1976); Littleton (U.S. Department of Housing and Urban Development, 1976); Lisbon (U.S. Department of Housing and Urban Development, 1976); Orford (U.S. Department of Housing and Urban Development, 1978); Rumney (U.S. Department of Housing and Urban Development, 1974); Wentworth (U.S. Department of Housing and Urban Development, 1974); Warren (U.S. Department of Housing and Urban Development, 1979); and Woodstock (U.S. Department of Housing and Urban Development, 1977); the previously printed FIRM for the Towns of Lincoln (FEMA, 1995) and Plymouth (FEMA, 1982); USDA NRCS soil survey map (U.S. Department of Agriculture, Soil Conservation Service, unpublished, and 1939), and topographic maps at a scale of 1:24,000 and 1:62,500 with a contour interval of 20 feet (U.S. Department of Interior, Geological Survey, 1967), 1:25,000 contour interval 20 feet (U.S. Department of Interior, Geological Survey, 1984) and flood-prone area maps (U.S. Department of Interior, Geological Survey, 1969); existing topographic, soils, and floodplain boundary publications for the and the review of existing flood boundary, topographic, and soils publications for the Town of Bristol (U.S. Geological Survey, 1925; U.S. Department of Agriculture, Soil Conservation Service, 1939) and aerial photographs in the City of Lebanon (City of Lebanon, 1984; U.S. Department of Agriculture, Soil Conservation Service, 1955).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AO), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 8). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Portions of the floodways for the Baker River, Connecticut River, and Pemigewasset River extend beyond the county boundary.

No floodways were calculated for Clay Brook, Grant Brook, Ham Branch, Hewes Brook, Trout Brook, portions of Ammonoosuc and Pemigewasset Rivers, and for portions of the Connecticut River within the Towns of Haverhill, Lyme, and Orford.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 8 for certain downstream cross sections of Dells Brook, Farr Brook, Goose Pond Brook, Knox River, Mascoma River, Sanborn Mill Brook, Slade Brook, and the South Branch Baker River are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

In Bristol, the flooding immediately upstream of the upper IPC dam is the result of impoundment behind the dam. Floodways are not delineated in ponding areas, nor was one computed for Newfound Lake.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 8, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ammonoosuc River								
A-AN*								
AO	107,363[1]	128	1,473	12.8	702.8	702.8	703.8	1.0
AP	111,653[1]	310	3,939	4.5	712.6	712.6	713.2	0.6
AQ	115,353[1]	263	2,802	6.3	728.2	728.2	728.6	0.4
AR	117,663[1]	200	1,506	11.7	744.1	744.1	745.0	0.9
AS	119,863[1]	110	1,013	17.4	760.1	760.1	760.1	0.0
AT	124,503[1]	192	1,345	13.1	806.9	806.9	807.1	0.2
AU	128,478[1]	160	2,086	7.9	833.8	833.8	834.6	0.8
AV	131,203[1]	105	1,067	15.5	842.1	842.1	842.2	0.1
AW	133,003[1]	194	3,362	4.9	868.2	868.2	869.2	1.0
AX	134,503[1]	150	2,271	7.3	869.3	869.3	870.3	1.0
Baker Brook								
A	290[2]	22	225	8.5	839.7	839.7	840.6	0.9
B	910[2]	59	269	7.1	847.1	847.1	847.8	0.7
C	1,030[2]	229	1,260	1.5	848.8	848.8	849.4	0.6
D	1,380[2]	172	747	2.6	849.0	849.0	849.6	0.6
E	1,900[2]	60	378	5.1	849.2	849.2	850.0	0.8
F	2,010[2]	46	372	5.1	849.4	849.4	850.4	1.0
G	2,238[2]	96	911	2.1	852.7	852.7	853.4	0.7
H	2,580[2]	232	1,583	1.2	852.8	852.8	853.6	0.8

[1]Feet above confluence with Connecticut River
[2]Feet above confluence with Ammonoosuc River
*Floodway not calculated

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

AMMONOOSUC RIVER – BAKER BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Baker River								
A	2,200	388	4,946	3.4	485.7	485.7	486.7	1.0
B	2,500	461	8,782	1.9	486.6	486.6	487.5	0.9
C	3,500	504	12,368	1.4	486.6	486.6	487.5	0.9
D	5,470	1,094	14,604	1.2	486.7	486.7	487.6	0.9
E	6,290	423	7,188	2.4	486.7	486.7	487.6	0.9
F	7,710	389	8,522	2.0	486.8	486.8	487.8	1.0
G	8,980	510	9,348	1.8	486.9	486.9	487.8	0.9
H	10,080	338	5,816	2.9	487.6	487.6	488.0	0.4
I	13,060	930	10,580	1.6	487.7	487.7	488.3	0.6
J	16,160	734	10,406	1.6	487.9	487.9	488.5	0.6
K	19,360	1,146	11,205	1.5	488.1	488.1	488.8	0.7
L	19,860	689	8,560	2.0	488.3	488.3	489.0	0.7
M	25,260	1,407[2]	12,114	1.4	488.5	488.5	489.5	1.0
N	26,760	895[2]	8,326	2.0	488.6	488.6	489.6	1.0
O	29,230	1,115	6,870	2.5	489.4	489.4	490.3	0.9
P	31,170	136	2,871	5.9	489.8	489.8	490.7	0.9
Q	33,955	840	8,622	2.0	490.9	490.9	491.9	1.0
R	40,570	415	4,622	3.7	491.8	491.8	492.8	1.0
S	44,915	660	5,172	3.3	494.0	494.0	495.0	1.0
T	46,840	300	3,766	4.5	495.2	495.2	496.1	0.9
U	53,530	391	3,685	4.6	499.4	499.4	500.0	0.6
V	57,194	306	2,119	6.8	500.9	500.9	501.7	0.8
W	57,270	365	3,811	3.8	501.4	501.4	502.1	0.7
X	63,405	650	4,922	2.9	503.1	503.1	504.1	1.0
Y	67,195	254	2,657	5.4	506.5	506.5	506.9	0.4
Z	71,950	310	2,948	4.9	511.7	511.7	512.7	1.0

[1]Feet above confluence with Pemigewasset River
[2]Combined Baker River and Sanborn Mill Brook floodway

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

BAKER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Baker River (continued)								
AA	77,520	585	5,601	2.6	520.3	520.3	521.0	0.7
AB	79,700	128	1,891	7.6	521.1	521.1	521.9	0.8
AC	79,755	140	2,334	6.2	523.0	523.0	523.6	0.6
AD	83,471	480	4,701	3.1	526.7	526.7	527.7	1.0
AE	86,443	143	1,941	7.4	529.3	529.3	530.3	1.0
AF	90,240	123	1,670	8.6	533.9	533.9	534.6	0.7
AG	92,880	100	1,206	11.3	539.1	539.1	539.9	0.8
AH	94,400	530	5,040	2.7	543.7	543.7	544.4	0.7
AI	96,850	169	1,578	8.6	546.0	546.0	546.2	0.2
AJ	99,380	160	2,136	6.4	551.5	551.5	552.5	1.0
AK	102,680	163	1,520	8.9	554.3	554.3	555.3	1.0
AL	102,770	275	1,825	7.5	554.7	554.7	555.3	0.6
AM	104,470	290	1,879	7.2	559.3	559.3	559.3	0.0
AN	106,470	100	1,258	10.8	564.1	564.1	566.2	0.8
AO	106,540	129	1,355	10.0	565.4	565.4	566.2	0.8
AP	109,260	240	2,684	5.1	573.1	573.1	573.4	0.3
AQ	112,390	619	3,794	3.6	578.7	578.7	579.1	0.4
AR	113,760	91	768	16.5	579.5	579.5	579.5	0.0
AS	113,840	230	2,023	6.3	584.2	584.2	584.2	0.0
AT	114,370	89	759	16.7	591.5	591.5	591.5	0.0
AU	114,440	92	775	16.4	594.1	594.1	594.1	0.0
AV	116,860	530	2,347	5.4	605.3	605.3	606.0	0.7
AW	118,350	970	5,140	2.5	609.0	609.0	609.8	0.8
AX	118,890	842	2,322	5.5	610.9	610.9	610.9	0.0
AY	121,540	623	1,736	7.3	626.0	626.0	626.0	0.0
AZ	123,540	493	3,222	3.9	637.5	637.5	637.6	0.1

[1]Feet above confluence with Pemigewasset River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

BAKER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Baker River (continued)								
BA	124,960	525	2,478	5.1	644.0	644.0	645.0	1.0
BB	125,480	515	2,565	5.0	648.3	648.3	648.9	0.6
BC	127,900	230	1,849	6.9	665.0	665.0	665.8	0.8
BD	128,900	63	689	18.4	670.3	670.3	670.3	0.0
BE	129,120	135	1,921	6.6	675.6	675.6	676.6	1.0
BF	129,203	190	2,303	5.5	676.9	676.9	677.6	0.7
BG	130,058	200	1,877	6.8	678.2	678.2	678.8	0.6
BH	131,258	500	3,086	4.1	685.2	685.2	685.2	0.0
BI	133,798	265	1,482	8.6	703.3	703.3	703.3	0.0
BJ	135,268	127	841	13.3	714.2	714.2	714.2	0.0
BK	135,448	85	687	16.3	716.5	716.5	716.5	0.0
BL	135,536	89	745	15.0	716.9	716.9	717.0	0.1
BM	137,396	236	1,183	9.5	733.2	733.2	733.2	0.0
BN	137,696	350	1,155	9.7	737.3	737.3	737.3	0.0
BO	137,768	344	2,519	4.4	738.6	738.6	739.4	0.8
BP	138,628	565	1,496	7.5	745.5	745.5	745.5	0.0
BQ	140,013	88	843	13.3	761.2	761.2	761.3	0.1
BR	140,090	530	3,071	3.6	764.7	764.7	764.7	0.0
BS	142,270	861	1,890	4.3	788.7	788.7	788.8	0.1
BT	145,460	482	1,562	5.2	850.9	850.9	850.9	0.0
BU	146,380	364	1,425	5.7	866.7	866.7	866.7	0.0
BV	146,780	70	843	9.7	870.9	870.9	871.2	0.3
BW	146,915	96	909	9.0	870.9	870.9	871.2	0.3
BX	149,325	140	660	12.4	926.7	926.7	926.8	0.1
BY	152,095	290	1,079	7.6	997.1	997.1	997.1	0.0
BZ	154,380	120	766	10.7	1,049.0	1,049.0	1,049.0	0.0

[1]Feet above confluence with Pemigewasset River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

BAKER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Baker River (continued)								
CA	156,010[1]	80	566	14.4	1,083.1	1,083.1	1,083.3	0.2
CB	156,230[1]	46	453	18.0	1,096.3	1,096.3	1,096.3	0.0
CC	156,290[1]	20	346	23.6	1,101.7	1,101.7	1,101.7	0.0
Beede Brook								
A	620[2]	98	462	2.6	736.6	736.6	737.6	1.0
B	750[2]	82	458	2.6	740.1	740.1	741.1	1.0
C	1,165[2]	77	433	2.2	740.5	740.5	741.5	1.0
D	1,735[2]	91	318	3.0	742.3	742.3	743.3	1.0
E	1,810[2]	113	624	1.5	744.5	744.5	745.5	1.0
F	2,180[2]	102	427	2.2	746.2	746.2	747.2	1.0
Cockermouth River								
A	70[3]	540	2,452	3.7	616.7	616.7	617.0	0.3
B	1,170[3]	172	1,537	5.8	619.3	619.3	620.3	1.0
C	1,240[3]	587	5,501	1.6	623.8	623.8	624.0	0.2
D	3,315[3]	1,000	2,935	3.1	626.6	626.6	627.1	0.5
E	5,090[3]	770	3,950	1.8	634.7	634.7	635.1	0.4
F	6,090[3]	540	2,162	3.4	638.2	638.2	638.9	0.7
G	7,090[3]	155	963	7.6	652.5	652.5	652.9	0.4

[1]Feet above confluence with Pemigewasset River
[2]Feet above confluence with Owl Brook
[3]Feet above Limit of Detailed Study

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

BAKER RIVER – BEEDE BROOK – COCKERMOUTH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Connecticut River								
A	2,465	459[2]	14,335	8.7	346.1	345.4[3]	345.8	0.4
B	5,565	581[2]	17,051	7.3	347.7	347.1[3]	347.6	0.5
C	6,675	547[2]	16,902	7.4	348.2	347.6[3]	348.0	0.4
D	8,640	418[2]	14,825	8.4	348.6	348.1[3]	348.5	0.4
E	9,795	1,003[2]	23,438	5.3	349.6	349.1[3]	349.7	0.6
F	13,030	501[2]	17,137	7.3	350.3	349.8[3]	350.5	0.7
G	16,695	500[2]	14,259	8.8	351.7	351.3[3]	351.9	0.6
H	18,446	540[2]	15,433	8.1	352.8	352.5[3]	353.0	0.5
I	20,551	520[2]	15,257	8.2	353.8	353.5[3]	354.0	0.5
J	22,221	497[2]	14,715	7.3	355.4	355.1[3]	355.8	0.7
K	23,416	453[2]	14,913	7.2	356.5	356.3[3]	356.8	0.5
L	25,366	403[2]	16,550	6.5	357.1	356.9[3]	357.4	0.5
M	26,571	796[2]	22,402	4.8	357.7	357.5[3]	358.0	0.5
N	28,726	631[2]	18,418	5.9	358.0	357.8[3]	358.3	0.5
O	34,116	482[2]	14,760	7.3	385.3	385.3	385.3	0.0
P	36,646	517[2]	14,311	7.5	386.2	386.2	386.2	0.0
Q	40,690	650	15,630	6.91	389.5	389.5	390.3	0.8
R	43,755	415	12,180	8.79	390.0	390.0	390.7	0.7
S	43,880	385	10,285	10.41	390.1	390.1	390.8	0.7
T	47,170	310	11,525	9.29	391.5	391.5	392.1	0.6
U	48,635	500	13,385	8.00	392.2	392.2	392.8	0.6
V	51,355	320	11,390	9.40	392.7	392.7	393.2	0.5
W	57,080	380	11,925	8.98	394.2	394.2	394.7	0.5
X	60,980	750	17,325	6.18	395.8	395.8	396.2	0.4
Y	66,360	670	17,090	6.25	396.6	396.6	397.0	0.4
Z	75,600	430	12,470	8.29	398.1	398.1	398.4	0.3

[1]Feet above county boundary
[2]Width extends beyond county boundary
[3]Elevation computed considering ice-jam effects

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

CONNECTICUT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Connecticut River (continued)								
AA	80,780[1]	330	12,560	8.23	399.2	399.2	399.4	0.2
AI-AJ*								
Dells Brook								
A	1,776[2]	40	143	2.9	714.4	712.0[3]	712.0	0.0
B	3,850[2]	21	64	6.6	720.2	720.2	720.2	0.0
C	4,630[2]	21	49	8.6	732.1	732.1	732.1	0.0
D	4,800[2]	47	180	9.2	736.5	736.5	736.9	0.4
E	4,900[2]	40	149	11.2	737.7	737.7	737.7	0.0
F	5,005[2]	89	400	4.1	745.3	745.3	746.2	0.9
G	5,455[2]	112	408	4.1	748.7	748.7	748.7	0.0
H	5,970[2]	49	167	9.9	755.4	755.4	756.4	1.0
I	6,015[2]	65	156	10.7	763.7	763.7	763.9	0.2
J	6,170[2]	118	512	3.2	765.7	765.7	766.7	1.0
K	6,621[2]	56	369	4.5	766.4	766.4	767.4	1.0
L	7,150[2]	30	136	12.2	773.8	773.8	773.8	0.0
M	7,240[2]	280	2,386	0.4	786.5	786.5	786.5	0.0
N	8,302[2]	39	295	3.5	786.6	786.6	786.8	0.2
O	8,440[2]	50	963	1.1	804.8	804.8	805.8	1.0
P	8,882[2]	50	865	1.2	804.8	804.8	805.8	1.0
Q	9,400[2]	50	633	1.6	804.8	804.8	805.8	1.0
R	11,100[2]	80	228	4.5	816.7	816.7	817.7	1.0
S	11,800[2]	50	89	7.6	831.3	831.3	831.8	0.5

[1]Feet above county boundary
[2]Feet above confluence with Ammonoosuc River
[3]Elevation computed without consideration of backwater effects from Ammonoosuc River

*Floodway not calculated

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

CONNECTICUT RIVER – DELLS BROOK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	950	671	3,493	8.7	721.4	721.4	722.4	1.0
B	1,328	217	1,824	16.6	726.6	726.6	726.6	0.0
C	2,020	200	2,155	14.1	735.5	735.5	735.5	0.0
D	3,799	245	1,896	16.0	756.9	756.9	757.2	0.3
E	4,307	385	2,944	10.3	762.2	762.2	762.8	0.6
F	4,711	440	2,667	11.4	764.6	764.6	764.6	0.0
G	5,288	404	2,241	13.5	770.7	770.7	770.7	0.0
H	5,516	305	2,107	14.4	775.4	775.4	775.5	0.1
I	6,613	287	2,010	15.1	787.3	787.3	787.3	0.0
J	6,784	384	2,720	11.1	790.2	790.2	790.2	0.0
K	7,320	305	2,035	14.6	793.8	793.8	794.0	0.2
L	7,866	290	3,069	9.2	803.2	803.2	803.8	0.6
M	8,264	280	1,993	14.2	811.3	811.3	811.3	0.0
N	9,170	400	2,371	11.9	823.3	823.3	824.1	0.8
O	9,515	488	2,708	11.2	829.1	829.1	830.0	0.9
P	10,480	169	1,691	17.9	842.1	842.1	842.3	0.2
Q	11,231	150	1,620	18.7	849.6	849.6	850.0	0.4
R	11,251	157	1,687	18.0	852.9	852.9	852.9	0.0
S	13,801	262	2,003	15.1	887.3	887.3	887.3	0.0
T	17,929	208	1,798	16.9	952.3	952.3	952.3	0.0
U	19,101	201	2,026	15.0	970.1	970.1	970.1	0.0
V	21,026	220	1,882	16.1	1,005.7	1,005.7	1,005.7	0.0
W	25,426	205	1,791	16.9	1,066.2	1,066.2	1,066.2	0.0

[1] FEET ABOVE CONFLUENCE WITH PEMIGEWASSET RIVER

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

EAST BRANCH PEMIGEWASSET RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	511	59	284	1.9	793.7	793.7	793.7	0.0
B	923	99	273	2.5	801.0	801.0	801.4	0.4
C	1,096	88	235	8.7	801.6	801.6	802.0	0.4
D	1,234	107	357	5.7	805.3	805.3	806.3	1.0
E	1,589	69	225	9.1	812.2	812.2	812.5	0.3
F	2,071	58	194	10.5	816.5	816.5	817.1	0.6
G	2,166	92	457	4.5	818.4	818.4	819.1	0.7
H	2,293	60	297	6.9	818.6	818.6	819.3	0.7
I	2,871	103	767	2.7	826.0	826.0	826.9	0.9
J	3,125	152	521	0.0	826.2	826.2	827.1	0.9

[1] FEET ABOVE CONFLUENCE WITH EAST BRANCH PEMIGEWASSET RIVER

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

EAST BRANCH PEMIGEWASSET RIVER OVERFLOW

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	100	105	238	1.9	786.5	783.5[2]	784.5	1.0
B	350	21	58	7.8	787.2	787.2	787.8	0.6
C	1,000	144	137	3.3	804.6	804.6	805.1	0.5
D	1,029	158	580	0.8	805.2	805.2	806.0	0.8
E	1,800	32	64	7.1	819.7	819.7	819.9	0.2
F	1,890	50	314	1.4	821.0	821.0	821.9	0.9
G	2,420	219	113	4.0	826.3	826.3	827.0	0.7
H	2,440	220	1,616	0.3	834.6	834.6	835.3	0.7

[1] FEET ABOVE CONFLUENCE WITH DELLS BROOK

[2] ELEVATION COMPUTED WITHOUT CONSIDERATION OF BACKWATER EFFECTS FROM DELLS BROOK

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

FARR BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Goose Pond Brook								
A	2,828	139	643	1.4	808.0	804.9[2]	805.9	1.0
B	4,688	79	507	1.8	808.0	806.7[2]	807.7	1.0
C	6,108	173	996	0.9	808.0	807.3[2]	808.3	1.0
D	8,196	157	821	1.1	808.4	808.4	809.4	1.0
E	9,540	195	1,038	0.5	808.5	808.5	809.5	1.0
F	10,184	115	602	0.8	808.7	808.7	809.7	1.0
G	10,396	87	556	0.9	809.4	809.4	810.4	1.0
H	11,292	73	483	1.0	809.4	809.4	810.4	1.0
I	13,308	420	2,097	0.2	809.5	809.5	810.5	1.0
J	14,668	209	960	0.5	809.6	809.6	810.6	1.0
K	15,388	77	236	2.1	810.7	810.7	811.7	1.0
L	15,628	97	375	1.3	811.3	811.3	812.3	1.0

[1]Feet above confluence with Masooma River
[2]Elevation computed without consideration of backwater effects from Mascoma River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

GOOSE POND BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ham Branch								
A	400	*	*	*	925.3	*	*	*
B	3,380	*	*	*	929.8	*	*	*
C	4,820	*	*	*	932.9	*	*	*
D	5,310	*	*	*	934.1	*	*	*
E	5,670	*	*	*	938.1	*	*	*
F	8,110	*	*	*	939.0	*	*	*
G	11,320	*	*	*	942.7	*	*	*
H	11,780	*	*	*	944.3	*	*	*
I	14,240	*	*	*	947.6	*	*	*
J	18,995	*	*	*	959.6	*	*	*
K	19,385	*	*	*	960.5	*	*	*
L	23,045	*	*	*	973.1	*	*	*
M	25,595	*	*	*	982.0	*	*	*
N	27,000	*	*	*	988.7	*	*	*
O	27,585	*	*	*	991.2	*	*	*

[1]Distance in feet above confluence with Connecticut River
*Data not available

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

HAM BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Indian River								
A	1,516	654	3,218	0.4	870.6	870.6	871.6	1.0
B	4,532	616	3,549	1.2	871.4	871.4	872.4	1.0
C	6,024	602	3,061	1.4	871.9	871.9	872.9	1.0
D	6,180	671	3,650	1.1	872.2	872.2	873.3	1.0
E	11,160	423	2,114	2.0	876.7	876.7	877.7	1.0
F	12,284	678	2,335	1.8	877.8	877.8	878.8	1.0
G	14,016	223	1,169	2.7	881.5	881.5	882.5	1.0
H	14,980	53	432	7.4	885.0	885.0	886.0	1.0
I	15,228	66	431	7.4	886.3	886.3	887.3	1.0
J	15,624	49	343	9.3	889.7	889.7	890.7	1.0
K	15,856	82	557	5.7	891.9	891.9	892.9	1.0
L	16,592	100	380	8.4	900.5	900.5	901.5	1.0
M	16,808	50	302	10.6	905.4	905.4	906.4	1.0
N	17,328	66	265	12.1	926.4	926.4	927.4	1.0
O	17,432	63	274	11.7	935.1	935.1	936.1	1.0
P	19,160	105	848	3.8	942.2	942.2	943.2	1.0
Q	19,920	127	1,117	2.9	944.0	944.0	945.0	1.0
R	20,596	293	1,959	1.6	944.5	944.5	945.5	1.0
S	21,036	227	1,626	2.0	944.8	944.8	945.8	1.0
T	21,192	271	1,908	1.7	944.9	944.9	945.9	1.0
U	22,148	368	1,518	2.1	945.8	945.8	946.8	1.0
V	22,588	406	2,233	1.4	946.8	946.8	947.8	1.0
W	22,848	361	2,372	1.4	947.2	947.2	948.2	1.0
X	23,472	906	4,878	0.7	947.3	947.3	948.3	1.0
Y	25,756	110	657	3.7	951.3	951.3	952.3	1.0
Z	27,048	89	560	4.4	952.9	952.9	953.9	1.0

[1]Feet above confluence with Mascoma River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

INDIAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Indian River (continued)								
AA	27,232	153	981	2.5	954.2	954.2	955.2	1.0
AB	28,472	717	5,327	0.5	954.4	954.4	955.4	1.0
AC	32,152	505	2,400	1.0	955.8	955.8	956.8	1.0
AD	34,672	682	2,515	1.0	956.8	956.8	957.8	1.0
AE	36,232	295	1,565	1.6	959.8	959.8	960.8	1.0
AF	38,112	590	2,129	1.2	961.1	961.1	962.1	1.0
AG	39,640	402	1,296	1.9	962.9	962.9	963.9	1.0
AH	41,264	224	1,107	2.2	966.4	966.4	967.4	1.0
AI	42,272	199	1,269	2.3	968.5	968.5	969.5	1.0
AJ	42,784	207	921	3.2	970.1	970.1	971.1	1.0
AK	43,640	283	1,111	2.6	971.8	971.8	972.8	1.0
AL	44,532	134	658	4.5	975.1	975.1	976.1	1.0
AM	45,592	53	379	7.7	981.3	981.3	982.3	1.0
AN	46,120	100	204	14.4	986.5	986.5	987.5	1.0
AO	47,188	82	554	5.3	993.9	993.9	994.9	1.0
AP	48,112	157	591	5.0	1,001.0	1,001.0	1,002.0	1.0
AQ	49,592	180	595	3.7	1,009.0	1,009.0	1,010.0	1.0
AR	50,664	39	239	9.2	1,024.4	1,024.4	1,025.4	1.0
AS	50,840	46	256	8.5	1,026.6	1,026.6	1,027.6	1.0
AT	52,304	32	235	9.2	1,051.0	1,051.0	1,052.0	1.0
AU	53,724	42	262	8.2	1,075.5	1,075.5	1,076.5	1.0
AV	55,720	44	258	7.4	1,094.7	1,094.7	1,095.7	1.0
AW	56,764	52	390	4.8	1,110.0	1,110.0	1,111.0	1.0
AX	57,832	261	1,569	1.2	1,110.6	1,110.6	1,111.6	1.0
AY	58,600	346	2,115	0.8	1,110.7	1,110.7	1,111.7	1.0
AZ	60,436	253	1,163	1.4	1,112.5	1,112.5	1,113.5	1.0
BA	63,608	203	770	1.9	1,121.9	1,121.9	1,122.9	1.0
BB	64,304	408	1,117	1.3	1,123.7	1,123.7	1,124.7	1.0

[1]Feet above confluence with Mascoma River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

INDIAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Knox River								
A	200	20	90	17.8	754.2	752.5[2]	753.5	1.0
B	780	230	1,503	1.0	759.8	759.8	760.8	1.0
C	1,988	112	331	4.6	765.4	765.4	766.4	1.0
D	3,012	36	177	8.2	773.6	773.6	774.6	1.0
E	3,896	40	210	6.6	779.1	779.1	780.1	1.0
F	5,068	34	184	7.2	785.7	785.7	786.7	1.0
G	5,896	35	194	6.6	800.0	800.0	801.0	1.0
H	6,080	24	142	8.9	801.9	801.9	802.9	1.0
I	6,608	30	127	9.7	815.4	815.4	816.4	1.0
J	6,720	90	488	2.5	818.9	818.9	819.9	1.0
K	7,440	39	189	6.5	824.4	824.4	825.4	1.0
L	8,396	64	253	4.7	833.8	833.8	834.8	1.0
M	8,752	16	72	4.8	836.7	836.7	837.7	1.0
N	9,116	18	78	4.4	839.9	839.9	840.9	1.0
O	9,260	23	155	2.2	844.1	844.1	845.1	1.0
P	9,676	18	61	5.3	854.4	854.4	855.4	1.0
Q	10,036	17	60	5.1	859.5	859.5	860.5	1.0
R	11,064	25	58	4.5	876.4	876.4	877.4	1.0
S	11,600	27	66	3.6	883.1	883.1	884.1	1.0

[1]Feet above confluence with Mascoma Lake
[2]Elevation computed without consideration of backwater effects from Mascoma Lake

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

KNOX RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lovejoy Brook								
A	596[1]	895	6,017	0.2	806.4	806.4	807.4	1.0
B	1,684[1]	579	2,925	0.4	806.5	806.5	807.5	1.0
C	2,232[1]	372	2,285	0.6	806.5	806.5	807.5	1.0
D	3,066[1]	353	1,562	0.8	807.0	807.0	808.0	1.0
Mascoma River								
A	1,320[2]	580	11,400	0.6	351.4	346.3[3]	347.3	1.0
B	2,218[2]	200	2,800	2.5	351.4	346.3[3]	347.3	1.0
C	2,904[2]	140	1,220	5.7	351.4	346.5[3]	347.5	1.0
D	3,221[2]	80	595	11.8	351.4	348.0[3]	348.4	0.4
E	3,854[2]	100	713	9.8	358.2	358.2	358.2	0.0
F	4,858[2]	90	675	10.4	370.3	370.3	370.7	0.4
G	6,072[2]	70	612	11.4	386.5	386.5	386.8	0.3
H	7,234[2]	80	670	10.4	402.4	402.4	402.7	0.3
I	7,498[2]	166	1,769	4.0	418.6	418.6	419.4	0.8
J	8,712[2]	90	523	13.4	425.4	425.4	425.4	0.0
K	14,520[2]	280	1,640	4.27	466.9	466.9	467.5	0.6
L	19,800[2]	120	914	7.03	470.1	470.1	470.2	0.1
M	24,816[2]	300	2,441	2.87	508.0	508.0	508.0	0.0
N	27,034[2]	108	579	12.09	561.5	561.5	561.9	0.4
O	29,568[2]	240	1,860	3.76	578.1	578.1	578.4	0.3
P	32,472[2]	160	825	8.49	584.2	584.2	585.0	0.8
Q	43,032[2]	140	566	12.37	658.9	658.9	658.9	0.0

[1]Feet above confluence with Mascoma River
[2]Feet above confluence with Connecticut River
[3]Elevation computed without consideration of backwater effects from Connecticut River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

LOVEJOY BROOK – MASCOMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mascoma River (continued)								
R	844	180	805	7.0	754.2	752.2[2]	753.2	1.0
S	1,260	127	745	7.6	757.0	757.0	758.0	1.0
T	2,444	147	783	7.2	763.3	763.3	764.3	1.0
U	2,668	147	797	7.1	764.8	764.8	765.8	1.0
V	3,120	98	707	8.0	767.6	767.6	768.6	1.0
W	3,520	172	789	7.2	768.9	768.9	769.9	1.0
X	3,956	288	1,805	3.1	769.9	769.9	770.9	1.0
Y	4,440	127	1,284	4.4	770.1	770.1	771.1	1.0
Z	4,688	149	641	8.8	771.8	771.8	772.8	1.0
AA	4,840	86	591	9.6	773.3	773.3	774.3	1.0
AB	5,876	72	476	11.9	781.6	781.6	782.6	1.0
AC	6,168	104	663	8.5	785.4	785.4	786.4	1.0
AD	6,712	140	1,846	3.1	802.6	802.6	803.6	1.0
AE	8,040	132	1,516	3.7	802.9	802.9	803.9	1.0
AF	8,128	92	501	11.3	802.9	802.9	803.9	1.0
AG	8,288	97	1,362	4.2	803.6	803.6	804.6	1.0
AH	10,368	1,556	12,514	0.4	803.9	803.9	804.9	1.0
AI	12,460	1,804	14,119	0.4	803.9	803.9	804.9	1.0
AJ	14,916	101	1,120	5.1	805.4	805.4	806.4	1.0
AK	16,580	337	2,889	2.0	805.9	805.9	806.9	1.0
AL	16,736	567	4,484	1.3	806.3	806.3	807.3	1.0
AM	16,940	647	5,121	1.1	806.4	806.4	807.4	1.0
AN	17,116	447	3,782	1.5	806.4	806.4	807.4	1.0
AO	19,332	359	2,984	1.9	807.4	807.4	808.4	1.0
AP	21,756	2,465	13,589	0.4	807.6	807.6	808.6	1.0
AQ	27,784	1,497	8,211	0.7	807.8	807.8	808.8	1.0
AR	31,036	300	1,899	3.0	809.1	809.1	810.1	1.0

[1]Feet above confluence with Mascoma Lake
[2]Elevation computed without consideration of backwater effects from Mascoma Lake

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

MASCOMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mascoma River (continued)								
AS	32,808	310	2,099	2.7	810.1	810.1	811.1	1.0
AT	33,472	89	1,027	5.5	810.4	810.4	811.4	1.0
AU	33,648	112	1,191	4.8	810.7	810.7	811.7	1.0
AV	34,604	158	1,397	4.1	811.3	811.3	812.3	1.0
AW	36,872	110	1,016	5.6	817.9	817.9	818.9	1.0
AX	38,440	57	512	11.1	825.7	825.7	826.7	1.0
AY	38,636	35	300	18.9	826.6	826.6	827.6	1.0
AZ	39,948	55	491	11.5	839.0	839.0	840.0	1.0
BA	40,308	40	402	14.1	840.6	840.6	841.6	1.0
BB	41,804	63	465	12.2	862.7	862.7	863.7	1.0
BC	42,984	346	3,485	1.1	869.7	869.7	870.7	1.0
BD	45,816	764	5,537	0.7	870.0	870.0	871.0	1.0
BE	47,128	795	5,256	0.7	870.3	870.3	871.3	1.0
BF	48,828	498	3,105	0.8	870.6	870.6	871.6	1.0
BG	49,124	886	5,615	0.4	870.7	870.7	871.7	1.0
BH	50,368	384	2,008	1.2	871.4	871.4	872.4	1.0
BI	52,168	94	819	3.3	872.7	872.7	873.7	1.0
BJ	53,700	425	2,704	1.0	873.3	873.3	874.3	1.0
BK	55,560	150	1,267	2.2	875.0	875.0	876.0	1.0
BL	57,608	507	3,191	0.8	875.6	875.6	876.6	1.0
BM	60,132	253	1,495	1.8	877.6	877.6	878.6	1.0
BN	64,604	417	1,775	1.5	881.9	881.9	882.9	1.0
BO	66,408	43	295	9.0	902.7	902.7	903.7	1.0
BP	67,072	51	295	9.0	912.3	912.3	913.3	1.0
BQ	67,468	33	242	11.0	920.8	920.8	921.8	1.0
BR	67,612	77	423	6.3	924.1	924.1	925.1	1.0
BS	68,432	108	959	2.8	925.3	925.3	926.3	1.0
BT	70,096	216	1,458	1.8	926.8	926.8	927.8	1.0

[1]Feet above confluence with Mascoma Lake

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

MASCOMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mascoma River (continued)								
BU	71,464[1]	320	1,760	1.5	928.3	928.3	929.3	1.0
BV	72,076[1]	52	377	7.0	931.7	931.7	932.7	1.0
BW	73,072[1]	48	300	8.8	941.0	941.0	942.0	1.0
BX	74,356[1]	30	231	11.5	955.8	955.8	956.8	1.0
BY	75,004[1]	59	296	9.0	962.7	962.7	963.7	1.0
BZ	75,764[1]	91	660	4.0	966.9	966.9	967.9	1.0
CA	77,256[1]	199	1,378	1.9	968.3	968.3	969.3	1.0
CB	78,724[1]	288	1,389	1.9	969.7	969.7	970.7	1.0
CC	78,876[1]	196	974	2.7	970.0	970.0	971.0	1.0
CD	80,048[1]	440	1,333	2.0	971.0	971.0	972.0	1.0
CE	80,780[1]	61	301	5.8	976.6	976.6	977.6	1.0
Mink Brook								
A	3,870[2]	100	555	6.6	389.5	388.3[3]	389.2	0.9
B	4,000[2]	120	1,030	3.5	392.0	392.0	392.0	0.0
C	4,740[2]	90	625	5.8	392.2	392.2	392.2	0.0
D	10,390[2]	95	360	9.3	497.0	497.0	497.0	0.0
E	10,530[2]	55	300	11.1	501.4	501.4	501.4	0.0
F	10,660[2]	50	365	9.1	504.5	504.5	504.5	0.0
G	11,270[2]	55	280	11.9	520.7	520.7	520.8	0.1
H	11,520[2]	105	820	4.1	530.4	530.4	530.4	0.0
I	13,860[2]	140	445	7.5	564.1	564.1	564.2	0.1
J	14,780[2]	130	650	5.1	569.0	569.0	569.0	0.0
K	16,400[2]	110	515	5.7	572.6	572.6	572.8	0.2
L	17,090[2]	130	345	8.5	583.5	583.5	583.6	0.1
M	19,405[2]	500	1,010	2.9	599.6	599.6	599.6	0.0
N	22,410[2]	495	700	4.2	618.4	618.4	618.4	0.0

[1]Feet above confluence with Mascoma Lake
[2]Feet above confluence with Connecticut River
[3]Elevation computed without consideration of backwater effects from the Connecticut River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

MASCOMA RIVER – MINK BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mink Brook (continued)								
O	25,420[1]	275	495	5.1	639.9	639.9	639.9	0.0
P	25,575[1]	100	895	2.8	649.5	649.5	649.5	0.0
Q	28,190[1]	55	230	9.6	697.5	697.5	697.5	0.0
R	28,320[1]	50	365	6.1	700.9	700.9	700.9	0.0
S	29,815[1]	50	205	10.8	746.3	746.3	746.3	0.0
T	29,945[1]	60	525	4.2	755.2	755.2	755.2	0.0
U	30,760[1]	55	215	10.3	763.1	763.1	763.2	0.1
V	30,880[1]	50	225	9.8	766.0	766.0	766.0	0.0
W	31,620[1]	45	215	10.3	791.0	791.0	791.0	0.0
X	31,750[1]	60	490	4.5	800.1	800.1	800.1	0.0
Y	32,050[1]	90	260	8.5	802.6	802.6	802.6	0.0
Z	32,175[1]	70	465	4.8	806.2	806.2	806.2	0.0
AA	32,300[1]	245	395	5.6	807.8	807.8	807.8	0.0
AB	33,040[1]	75	285	7.8	811.8	811.8	812.0	0.2
AC	34,770[1]	100	215	6.7	836.9	836.9	837.0	0.1
AD	34,900[1]	35	140	10.3	839.7	839.7	839.7	0.0
AE	35,920[1]	100	225	6.4	857.7	857.7	857.8	0.1
AF	36,050[1]	35	140	10.3	860.7	860.7	860.7	0.0
AG	37,400[1]	40	145	10.0	883.4	883.4	883.4	0.0
AH	37,540[1]	35	315	4.6	890.4	890.4	890.4	0.0
Monahan Brook								
A	105[2]	70	465	2.21	818.4	818.4	818.4	0.0
B	615[2]	85	165	6.23	820.9	820.9	820.9	0.0
C	740[2]	75	415	2.48	825.9	825.9	825.9	0.0
D	1,510[2]	90	335	3.07	826.2	826.2	826.2	0.0
E	4,180[2]	120	200	3.42	846.8	846.8	847.2	0.4
F	4,335[2]	125	190	3.60	848.4	848.4	848.7	0.3

[1]Feet above confluence with Connecticut River
[2]Feet above confluence with Mink Brook

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

MINK BROOK – MONAHAN BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Newfound River								
A	995[1]	54	280	9.5	449.3	449.3	450.3	1.0
B	1,142[1]	37	319	8.4	453.0	453.0	454.0	1.0
C	1,652[1]	75	656	4.0	454.8	454.8	455.8	1.0
D	2,107[1]	73	888	3.0	455.1	455.1	456.1	1.0
E	2,225[1]	88	793	3.4	445.5	455.5	456.5	1.0
F	2,725[1]	260	1,409	1.9	455.7	455.7	456.7	1.0
G	3,875[1]	629	3,662	0.7	456.0	456.0	456.7	0.7
H	5,825[1]	521	931	2.9	459.1	459.1	460.1	1.0
I	7,235[1]	57	353	7.5	469.6	469.6	470.6	1.0
J	8,240[1]	132	1,225	2.2	491.0	491.0	492.0	1.0
Orange Brook								
A	3,160[2]	1,078	1,823	2.1	960.6	960.6	961.6	1.0
B	4,030[2]	175	479	7.8	974.9	974.9	975.9	1.0
C	4,300[2]	36	238	15.7	979.5	979.5	980.5	1.0

[1]Feet above confluence with Pemigewasset River
[2]Feet above confluence with Indian River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

NEWFOUND RIVER – ORANGE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ore Hill Brook								
A	600	35	298	16.6	718.6	718.6	718.6	0.0
B	830	80	651	7.6	725.2	725.2	725.3	0.1
C	896	90	681	7.3	725.4	725.4	725.9	0.5
D	1,316	120	666	7.4	731.8	731.8	731.9	0.1
E	1,502	158	1,191	4.2	735.3	735.3	736.2	0.9
F	2,298	126	940	5.3	738.6	738.6	739.4	0.8
G	3,098	90	569	8.7	744.6	744.6	745.5	0.9
H	5,092	370	1,699	2.9	756.3	756.3	756.9	0.6
I	5,160	300	1,524	3.2	756.8	756.8	757.4	0.6
J	6,390	155	1,167	4.2	765.1	765.1	765.9	0.8
K	6,570	88	602	8.2	767.1	767.1	767.3	0.2
L	6,650	328	2,888	1.7	775.5	775.5	776.1	0.6
M	8,145	520	5,975	0.8	776.5	776.5	777.1	0.6

[1]Feet above confluence with Baker River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

ORE HILL BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Owl Brook								
A	13,300[1]	88	461	4.7	732.9	732.9	733.9	1.0
B	13,350[1]	29	4,664	0.5	735.5	735.5	736.5	1.0
C	13,830[1]	81	549	3.9	735.9	735.9	736.9	1.0
D	14,260[1]	88	534	2.2	736.4	736.4	737.4	1.0
E	15,220[1]	146	460	2.5	739.0	739.0	740.0	1.0
F	16,905[1]	56	231	4.5	750.2	750.2	751.2	1.0
G	17,795[1]	46	197	5.2	756.2	756.2	757.2	1.0
H	18,825[1]	22	124	7.6	762.4	762.4	763.4	1.0
I	18,894[1]	39	278	3.4	764.7	764.7	765.7	1.0
J	19,864[1]	65	240	3.9	769.0	769.0	770.0	1.0
K	21,099[1]	73	257	3.0	776.3	776.3	777.3	1.0
L	22,694[1]	112	270	2.2	782.7	782.7	783.7	1.0
M	23,989[1]	20	86	6.2	792.9	792.9	793.9	1.0
N	24,496[1]	37	221	2.4	799.1	799.1	800.1	1.0
Palmer Brook								
A	150[2]	50	225	6.7	826.0	826.0	827.0	1.0
B	400[2]	45	254	5.9	838.4	838.4	839.4	1.0
C	480[2]	87	509	2.9	847.4	847.4	848.4	1.0
D	575[2]	108	557	2.7	847.6	847.6	848.5	0.9
E	1,050[2]	25	125	12.0	864.6	864.6	865.3	0.7
F	2,020[2]	70	242	6.2	885.1	885.1	885.9	0.8
G	2,550[2]	88	272	5.5	898.7	898.7	899.7	1.0
H	2,580[2]	100	352	4.3	899.7	899.7	900.2	0.5
I	2,980[2]	26	223	6.7	902.9	902.9	903.7	0.8
J	3,010[2]	57	286	5.2	906.5	906.5	907.3	0.8
K	4,120[2]	46	146	10.3	924.9	924.9	925.7	0.8

[1]Feet above confluence with Squam River
[2]Feet above confluence with Ammonoosuc River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

OWL BROOK – PALMER BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pemigewasset River								
A	900	291[2]	7,740	8.9	467.6	467.6	468.6	1.0
B	3,450	281[2]	6,900	10.0	468.9	468.9	469.8	0.9
C	5,350	879[2]	19,300	3.6	470.8	470.8	471.6	0.8
D	7,600	395[2]	9,900	7.0	471.0	471.0	471.7	0.7
E	9,900	320[2]	8,650	8.0	471.6	471.6	472.3	0.7
F	12,080	387[2]	10,000	6.9	472.5	472.5	473.2	0.7
G	14,300	351[2]	9,630	7.2	473.2	473.2	473.9	0.7
H	16,400	312[2]	8,680	8.0	473.9	473.9	474.6	0.7
I	18,860	374[2]	8,810	7.8	474.8	474.8	475.4	0.6
J	20,200	332[2]	7,630	9.0	475.2	475.2	475.9	0.7
K	23,170	202	5,370	11.8	477.1	477.1	477.6	0.5
L	25,900	358[2]	10,800	5.9	479.4	479.4	480.2	0.8
M	28,120	432[2]	9,870	6.4	479.7	479.7	480.5	0.8
N	29,800	318[2]	9,020	7.0	480.1	480.1	480.9	0.8
O	32,510	219[2]	6,920	9.2	480.7	480.7	481.5	0.8
P	34,150	307	8,388	7.8	481.2	481.2	482.0	0.8
Q	34,750	371	7,555	8.4	481.3	481.3	482.1	0.8
R	35,690	423	9,743	7.2	481.8	481.8	482.6	0.8
S	40,540	4,218	66,410	2.5	483.0	483.0	483.8	0.8
T	47,690	3,196	65,995	0.9	483.2	483.2	484.0	0.8
U	50,720	2,684	52,742	1.2	483.3	483.3	484.1	0.8
V	52,960	1,845[3]	17,911	3.5	483.3	483.3	484.1	0.8
W	54,250	1,824[3]	11,427	5.4	483.6	483.6	484.3	0.7
X	58,525	357	8,050	7.7	484.9	484.9	485.7	0.8
Y	61,275	465	8,483	5.4	486.6	486.6	487.3	0.7
Z	63,525	304	4,691	9.7	488.0	488.0	488.7	0.7
AA	64,045	198	3,731	12.2	488.7	488.7	489.7	1.0

[1]Feet above Limit of Detailed Study (approximately 11,800 feet upstream of River Road)
[2]Width extends beyond county boundary
[3]Width includes islands

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

PEMIGEWASSET RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD 29)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pemigewasset River (continued)								
AB	0	*	*	*	608.3	*	*	*
AC	3,720	*	*	*	615.6	*	*	*
AD	7,000	*	*	*	624.3	*	*	*
AE	8,810	*	*	*	629.3	*	*	*
AF	10,590	*	*	*	637.8	*	*	*
AG	14,620	*	*	*	647.1	*	*	*
AH	19,650	*	*	*	665.2[2]	*	*	*

[1]Feet above Limit of Detailed Study (approximately 2,500 downstream of I-93 North)
[2]The elevation shown on the FIRM is in NAVD 88. See section 3.3 of this FIS for the conversion factor between NGVD 29 and NAVD 88

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

PEMIGEWASSET RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD 88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pemigewasset River (continued)								
AI	23,950	*	*	*	679.0	*	*	*
AJ	26,470	*	*	*	689.4	*	*	*
AK	29,110	*	*	*	704.1	*	*	*
AL	29,910	*	*	*	710.4	*	*	*
AM	31,950	*	*	*	719.6	*	*	*
AN	32,520	*	*	*	722.1	*	*	*
AO	33,040	*	*	*	725.2	*	*	*
AP	35,980	*	*	*	754.9	*	*	*
AQ	36,660	*	*	*	760.8	*	*	*

[1]Feet above Limit of Detailed Study (approximately 2,500 downstream of I-93 North)

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

PEMIGEWASSET RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Punch Brook								
A	1,255[1]	204	1,253	2.6	646.5	646.5	647.5	1.0
B	1,750[1]	219	648	5.1	661.4	661.4	661.4	0.0
C	3,270[1]	65	408	8.1	717.1	717.1	717.4	0.3
D	3,860[1]	75	404	8.2	757.6	757.6	757.8	0.2
E	4,410[1]	64	502	6.6	775.8	775.8	776.7	0.9
F	4,574[1]	85	700	4.7	787.1	787.1	787.1	0.0
G	5,194[1]	55	371	8.9	813.7	813.7	813.7	0.0
H	5,387[1]	85	851	3.9	821.5	821.5	822.3	0.8
Sanborn Mill Brook								
A	3,200[2]	247	1,051	2.8	488.4	484.6[3]	485.5	0.9
B	3,500[2]	268	1,153	2.5	488.4	485.0[3]	485.9	0.9
C	3,750[2]	126	1,720	1.7	491.6	491.6	492.6	1.0
D	4,490[2]	139	1,142	2.5	493.1	493.1	493.6	0.5
E	6,090[2]	68	503	5.8	497.4	497.4	498.0	0.6
F	6,200[2]	80	708	4.1	500.9	500.9	501.1	0.2
G	7,210[2]	104	885	3.3	502.0	502.0	502.6	0.6
H	8,000[2]	120	1,058	2.7	502.7	502.7	503.5	0.8
I	9,020[2]	107	818	3.1	503.5	503.5	504.5	1.0
J	10,350[2]	89	912	2.7	506.8	506.8	507.1	0.3
K	11,460[2]	113	629	4.0	507.9	507.9	508.9	1.0
L	12,140[2]	62	411	5.5	511.0	511.0	512.0	1.0
M	12,940[2]	52	206	10.9	528.4	528.4	528.7	0.3

[1]Feet above confluence with Cockermouth River
[2]Feet above confluence with Baker River
[3]Elevation computed without consideration of backwater effects from the Baker River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

PUNCH BROOK – SANBORN MILL BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Slade Brook								
A	110[1]	170	400	1.81	397.6	387.5[3]	388.5	1.0
B	240[1]	55	115	6.30	397.9	392.9[3]	392.9	0.0
C	3,650[1]	35	100	7.24	553.0	553.0	553.0	0.0
South Branch Baker River								
A	50[2]	814	1,337	6.6	539.7	534.4[4]	534.6	0.2
B	141[2]	822	3,787	2.3	540.2	540.2	540.2	0.0
C	686[2]	160	828	10.6	540.2	540.2	540.2	0.0
D	1,206[2]	251	1,135	7.8	547.9	547.9	547.9	0.0
E	1,606[2]	166	1,467	6.0	552.4	552.4	552.4	0.0
F	1,679[2]	154	1,634	5.4	553.9	553.9	553.9	0.0
G	2,354[2]	140	1,474	6.0	555.5	555.5	555.5	0.0
H	3,994[2]	70	704	12.5	559.1	559.1	559.4	0.3
I	4,394[2]	96	901	9.8	562.3	562.3	562.6	0.3

[1]Feet above confluence with Connecticut River
[2]Feet above confluence with Baker River
[3]Elevation computed without consideration of backwater effects from Connecticut River
[4]Elevation computed without consideration of backwater effects from Baker River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

SLADE BROOK – SOUTH BRANCH BAKER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Stinson Brook								
A	2,490	251	1,294	6.3	501.9	501.9	502.7	0.8
B	2,649	160	1,288	6.4	508.7	508.7	508.7	0.0
C	2,679	287	2,033	4.0	509.1	509.1	509.7	0.6
D	3,780	119	800	10.2	530.0	530.0	530.2	0.2
E	4,120	55	500	14.7	552.5	552.5	552.5	0.0
F	5,750	80	651	12.6	583.1	583.1	583.2	0.1
G	6,320	75	660	12.4	596.5	596.5	596.8	0.3
H	7,220	110	762	10.8	613.1	613.1	613.1	0.0
I	8,255	290	1,682	4.9	626.3	626.3	627.0	0.7
J	8,470	69	677	12.1	628.1	628.1	628.5	0.4
K	8,570	30	395	20.7	632.1	632.1	632.8	0.7

[1]Feet above confluence with Baker River

TABLE 8

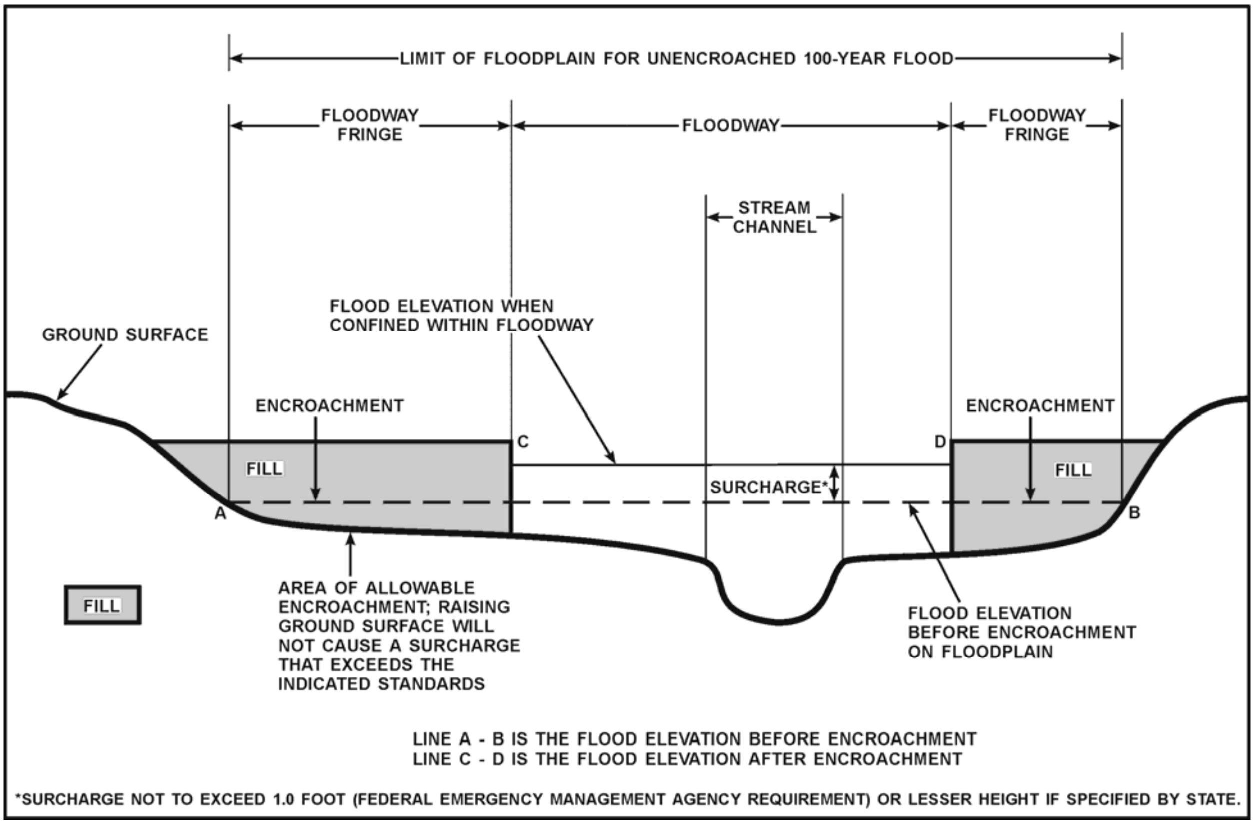
FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

STINSON BROOK

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.



FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Grafton County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community, up to and including this countywide FIS, are presented in Table 9, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Alexandria, Town of	June 28, 1974	April 1, 1977 September 21, 1979	June 8, 1998	February 20, 2008
Ashland, Town of	June 28, 1974	October 31, 1975	April 2, 1986	February 20, 2008
Bath, Town of	March 1, 1974	May 28, 1976 October 15, 1976	April 15, 1992	February 20, 2008
Benton, Town of	February 20, 2008	None	February 20, 2008	
Bethlehem, Town of	June 28, 1974	March 25, 1977	April 15, 1986	February 20, 2008
Bridgewater, Town of	August 16, 1974	December 24, 1976	June 17, 1991	June 4, 1996 February 20, 2008
Bristol, Town of	June 21, 1974	September 26, 1975	April 15, 1980	May 18, 1998 February 20, 2008
Campton, Town of	April 5, 1974	September 17, 1976	April 2, 1986	February 20, 2008
Canaan, Town of	June 28, 1974	March 18,1977	May 17, 1988	February 20, 2008
Dorchester, Town of	March 14, 1975	None	February 20, 2008	
Easton, Town of	November 8, 1974	None	April 2, 1986	February 20, 2008
Ellsworth, Town of	February 20, 2008	None	February 20, 2008	
Enfield, Town of	March 8, 1974	March 19, 1976	May 17, 1988	February 20, 2008
Franconia, Town of	February 21, 1975	March 4, 1977	May 15, 1991	February 20, 2008

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Grafton County, Unincorporated Areas	None	None	None	None
Grafton, Town of	January 17, 1975	October 5, 1979	February 20, 2008	February 20, 2008
Groton, Town of	November 29, 1974	None	April 18, 1983	February 20, 2008
Hanover, Town of	May 31, 1974	October 29, 1976	July 3, 1978	February 20, 2008
Haverhill, Town of	March 8, 1974	September 24, 1976	May 3, 1990	February 20, 2008
Hebron, Town of	January 3, 1975	None	April 2, 1986	July 6, 1998 February 20, 2008
Holderness, Town of	March 22, 1974	December 10, 1976	April 15, 1981	June 20, 2001 February 20, 2008
Landaff, Town of	August 16, 1974	November 19, 1976 September 7, 1979	February 20, 2008	
Lebanon, City of	September 20, 1974	None	June 4, 1980	July 16, 1982 May 19, 1987 August 15, 1990 February 20, 2008
Lincoln, Town of	June 28, 1974	March 11, 1977 September 7, 1979	April 20, 2000	
Lisbon, Town of	February 21, 1975	October 22, 1976	August 19, 1986	February 20, 2008
Littleton, Town of	May 31, 1974	December 10, 1976	May 17, 1989	February 20, 2008
Lyman, Town of	December 17, 1976	March 11, 1977	April 2, 1986	February 20, 2008

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Lyme, Town of	June 28, 1974	November 5, 1976	April 16, 1993	February 20, 2008
Monroe, Town of	November 29, 1974	None	February 20, 2008	
Orange, Town of	January 10, 1975	None	February 20, 2008	
Orford, Town of	July 26, 1977	October 10, 1978	April 15, 1992	February 20, 2008
Piermont, Town of	February 21, 1975	None	April 2, 1986	February 20, 2008
Plymouth, Town of	May 3, 1974	April 9, 1976	May 3, 1982	May 21, 2001 February 20, 2008
Rumney, Town of	March 15, 1974	March 11, 1977 September 28, 1979	April 18, 1983	February 20, 2008
Sugar Hill, Town of	August 23, 1974	December 10, 1976	April 2, 1986	February 20, 2008
Thornton, Town of	June 28, 1974	March 25, 1977	April 2, 1986	February 20, 2008
Warren, Town of	September 13, 1974	March 11, 1977 May 18, 1979	April 18, 1983	February 20, 2008
Waterville Valley, Town of	January 10, 1975	None	April 2, 1986	February 20, 2008
Wentworth, Town of	August 16, 1974	April 8, 1977	April 18,1983	February 20, 2008
Woodstock, Town of	June 28, 1974	April 8, 1977	May 15, 1991	April 6, 2000 February 20, 2008

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAFTON COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

FISs have been prepared for Windsor County, Vermont (all Jurisdictions), and the following communities within Orange County, Vermont: Town of Bradford (FEMA, June 1991), Village of Bradford (FEMA, June 1998), Town of Fairlee (FEMA, June 1991),Town of Newbury (FEMA, July 1999), and the Town of Thetford (FEMA, December 1999); the following communities within Caledonia County, Vermont: Town of Barnet (FEMA, May 1988), Town of Ryegate (FEMA, June 1991), Town of Concord, Vermont (FEMA 1992); and Sullivan County, New Hampshire (All Jurisdictions) (currently being revised).

An FHBM has been prepared for the Village of Newbury, Vermont (FEMA, November 1976). A FIRM has been prepared for the following towns within Coos County, New Hampshire: Town of Dalton (FEMA 1985), Town of Carroll (FEMA, 1986), and Town of Whitefield (FEMA, 1986); the following towns within Carroll County, New Hampshire: Town of Albany (FEMA, 1984), Town of Bartlett (FEMA, 1995), Town of Moultonborough (FEMA, 2000), the Town of Sandwich (FEMA, 1993), and the Town of New Hampton, Belknap County, New Hampshire (FEMA, 1986); and the following towns within Merrimack County: Town of Danbury (FEMA, 2003), Town of Hill (FEMA 1986), and the Town of Wilmot (FEMA 1986).

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Grafton County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Grafton County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, 99 High Street, 6th Floor, Boston, Massachusetts 02110.

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